Bird and Bat Pre-Construction Surveys for Kingdom Community Wind Project in Lowell, Vermont

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Executive Summary

Acting on behalf of Green Mountain Power (GMP), Vermont Environmental Research Associates (VERA) contracted Stantec Consulting Services Inc. (Stantec) to conduct ecological surveys at the proposed Kingdom Community Wind Project (KCW, Project) in Lowell, Vermont (Figure 1-1). The surveys are part of the planning process by KCW for a proposed wind energy project that will include 20 to 24, 1.5 to 3.0 megawatt (MW) turbines along 3.2 miles of the Lowell Mountains ridgeline.

Nocturnal Radar Survey

Marine X-band radar units collected data for 20 nights between September 10 and October 13, 2008 and 15 nights between April 24 and May 29, 2009. The intent of radar surveys was to document several key metrics associated with nocturnal migration and biological activity of birds and bats ("targets") within the Project area: passage rates, flight heights, and flight direction.

Nightly passage rates in the fall of 2008 varied from 12 targets/kilometer/hour (t/km/hr) to 1372 t/km/h, with an overall passage rate of 356 t/km/hr. Nightly passage rates in the spring of 2009 varied from 8 t/km/hr to 751 t/km/h, with an overall passage rate of 223 t/km/hr. Spring radar results had lower passage rates with less night-to-night variation than results seen from the fall survey. Mean flight direction was $226^{\circ} \pm 60^{\circ}$ during the fall and $80.5^{\circ} \pm 71.4^{\circ}$ during the spring. This southwesterly direction in the fall and northeasterly direction in the spring (roughly parallel to the Lowell Mountains ridge line) was expected during fall and spring migration. The seasonal mean flight height was 350 ± 9 meters (m) in the fall and 298 ± 10 m in the spring. The percent of targets observed flying below 135 m was 16 percent in the fall and 22 percent in the spring.

Diurnal Raptor Survey

Stantec conducted 10 raptor migration surveys, between April 15 and June 1, to establish baseline data for spring raptor migration activity in the vicinity of the KCW Project area. The purpose of the raptor surveys was to sample migration activity at a central and prominent location within the Project area, to document the species that occur in the vicinity of the Project, and the specific flights heights, flight path locations, and other flight behaviors of raptors within or in the vicinity of the Project.

A total of 134 raptors, representing 13 species, were observed during the survey period. Turkey vulture (*Cathartes aura*) and red-tailed hawk (*Buteo jamaicensis*) were the most commonly observed species. Daily counts ranged from 2 to 36 raptors, overall passage rate was 1.81 raptors/hour, and 88 percent of all raptor observations occurred within the Project area. Among those raptors occurring within the Project boundary, 69 percent were flying at or below 135 m for at least a portion of their flight through the proposed turbine areas. No federally endangered or threatened raptor species were observed during the fall surveys. One state endangered



species, the bald eagle (*Haliaeetus leucocephalus*), was observed 1,060 m outside the Project area boundary at a height of 500 m above ground level.

Breeding Bird Survey

Stantec conducted two rounds of breeding bird surveys during June 2009. The objective of the survey was to determine the species composition, abundance, diversity, and distribution of all breeding bird species acoustically or visually detected in the Project area. The survey additionally focused effort on documenting the potential occurrence of Bicknell's thrush (*Catharus bicknelli*; species of state conservation concern), state or federally threatened or endangered species, other species of conservation concern, and species included as priority species under the Vermont Wildlife Action Plan (2005) priority species list.

One round of surveys was conducted between June 10 and 12, and one round was conducted between June 21 and 23. A total of 25 point counts were sampled during each round, which included 17 impact and 8 control points. Each of the points was surveyed twice, resulting in observations of 301 individual birds. Thirty-five species were detected during point count surveys, and one additional species was detected incidentally between surveys resulting in a total of 36 species detected within the Project area. Thirty-three species were detected at turbine points and 22 species were detected at control points. The mean overall relative abundance of birds for the entire survey period was 3.71 birds per turbine point and 4.13 birds per control point. Species richness ranged from 2 to 9 for individual turbine points and from 3 to 9 for individual control points. No Bicknell's thrush were detected during playback surveys at each point count location.

The majority of birds found within the Project area are common within the region, and no state or federally threatened or endangered species were detected in the Project area. There were seven species observed in the Project area that are included as priority species under the Vermont Wildlife Action Plan Priority Species list (VDFW 2005); however, these species are all considered demonstrably secure in the state, and regionally abundant (with the exception of Canada warbler, *Wilsonia canadensis*).

Acoustic Bat Survey

The intent of acoustic bat surveys was to document bat activity patterns and general species composition from April through October. Five Anabat SD1 detectors at three locations along the ridgeline recorded a total of 10,130 call files over a period of 856 detector-nights between April 16, 2009 and October 18, 2009, resulting in an overall detection rate of 11.8 calls per detector-night. Nightly bat activity was variable at all detectors, but monthly detection rates generally increased through July, then decreased through the end of the survey. The South Tree detector recorded the most calls overall (n = 5,010) and had the highest detection rate (35.3 calls/detector-night).

Twenty-one percent of all recorded call sequences belonged to the big brown (*Eptesicus fuscus*)/silver-haired bat (*Lasionycteris noctivagans*) guild, 18 percent were assigned to the



Myotis guild, and less than 1 percent of calls were assigned to the red bat (Lasiurus borealis)/tricolored bat (Perimyotis subflavus) guild and the hoary bat (L. cinereus) guild. Sixty-two percent were assigned to the Unknown guild. At the North and South Tower detectors (15 m above ground level), the big brown bat/silver-haired bat guild was the most common species guild identified. At the North and South Tree detectors, the Myotis guild was the most common species guild identified (1.5 m above ground level). Results from the Central Tree detector (10 m above ground level) were most similar to the tower detectors, with the BBSH guild the most common species guild identified.

Small-footed Bat Habitat Assessment

A remote assessment with a follow-up site visit was used to determine whether there was any potential eastern small-footed bat (*Myotis leibii*) day-roost habitat within 3 miles of the Project area. Three characteristics of what is thought to be the most suitable habitat for day-roosts – (1) steep slopes, (2) visible rock formations, and (3) southerly aspect – were used to identify potential roosting locations. Using the USGS National Elevation Dataset, no areas were identified within three miles of the Project area that had slopes greater than 30°. During a site visit in which 68.5 miles of road were traveled within 3 miles of the Project area, a total of four sites were identified as having exposed rock. None of these sites were categorized as potential habitat within the 3-mile Project area buffer: one of four sites was within 3 miles of the Project area but rock formations did not have a southerly aspect; two of four sites had rock formations with a southerly aspect but were 5 to 7 miles away from the Project area (2 to 4 miles from the Project area buffer); and one of four sites had eastern-facing rock formation and was 6 miles away from the Project area (3 miles away from the Project area buffer).



Table of Contents

| EXI | ECUTIVE SUMMARY | E.1 |
|-----|--|-----|
| | INTRODUCTION | |
| 1.1 | PROJECT BACKGROUND | 1 |
| 1.2 | PROJECT AREA DESCRIPTION | 2 |
| 2.0 | NOCTURNAL RADAR SURVEY | 4 |
| 2.1 | INTRODUCTION | 4 |
| 2.2 | SURVEY DESIGN | 4 |
| 2.3 | DATA COLLECTION METHODS | 7 |
| | 2.3.1 Radar Data | |
| | 2.3.2 Weather Data | 8 |
| 2.4 | DATA ANALYSIS METHODS | 8 |
| | 2.4.1 Radar Data | 8 |
| | 2.4.2 Weather Data | 8 |
| 2.5 | RESULTS | |
| | 2.5.1 Passage Rates | |
| | 2.5.2 Flight Direction | |
| | 2.5.3 Flight Altitude | |
| | 2.5.4 Weather Data | |
| 2.6 | DISCUSSION | 17 |
| 3.0 | DIURNAL RAPTOR SURVEY | 20 |
| 3.1 | INTRODUCTION | 20 |
| 3.2 | DATA COLLECTION METHODS | 20 |
| | 3.2.1 Field Surveys | |
| | 3.2.2 Survey Location | 22 |
| 3.3 | DATA ANALYSIS METHODS | 23 |
| 3.4 | RESULTS | 23 |
| | 3.4.1 Species of Conservation Concern | 28 |
| | 3.4.2 Incidental Bird Observations | 28 |
| 3.5 | DISCUSSION | 29 |
| 4.0 | BREEDING BIRD SURVEYS | 32 |
| 4.1 | | |
| 42 | DATA COLLECTION METHODS | |
| | 4.2.1 Breeding Bird Survey Point Counts | |
| | 4.2.2 Bicknell's Thrush Playback Survey | |
| | 4.2.3 Data Summary and Analysis | |
| 4.3 | RESULTS | |
| | 4.3.1 BBS Point Counts | |
| | 4.3.2 Habitat Types Documented in Project Area | |



| | 4.3.2.1 | Deciduous forest | 36 |
|-----|--------------------|--|---------------|
| | 4.3.2.2 | Conifer forest | |
| | 4.3.2.3 | Deciduous/conifer mixed forest | 36 |
| | 4.3.3 | Incidental Observations | 37 |
| | 4.3.4 | Bicknell's thrush playback surveys | 38 |
| 4.4 | DISCUS | SSION | |
| 5.0 | ACOUS | TIC BAT SURVEY | |
| 5.1 | INTROD | DUCTION | 40 |
| 5.2 | SURVE | Y DESIGN | |
| | 5.2.1 | Data Collection Methods | |
| | 5.2.2 | Site Selection | |
| | 5.2.3 | Data Analysis Methods | |
| 5.3 | | rs | |
| | 5.3.1 | Seasonal Activity Levels | |
| | 5.3.2 | Timing of Activity | |
| - 1 | 5.3.3 | Species Composition | |
| 5.4 | DISCUS | SSION | 53 |
| | | FOOTED BAT HABITAT ASSESSMENT | _ |
| | | DUCTION | |
| | | DS | |
| 6.3 | RESUL ₁ | rs | 59 |
| 6.4 | DISCUS | SSION | |
| 7.0 | LITERA | TURE CITED | |
| Tak | oles | | |
| Tab | ole 3-1 | Number of observations and average flight heights for each position the Kingdom Community Wind Project, Spring 2009. | n category at |
| Tab | ole 3-2 | Non-raptor avian species observed incidentally during raptor survey Community Wind, Spring 2009. | s at Kingdom |
| Tab | ole 4-1 | Summary of breeding bird point count results by habitat type – Impa Summer 2009. | act points, |
| Tab | ole 4-2 | Summary of breeding bird point count results by habitat type – Con Summer 2009. | trol points, |
| Tab | le 4-3 | Birds observed incidentally between point count surveys - Summer | 2009. |
| Tab | ole 4-4 | Species observed in the Project Area that are included under the 20 Wildlife Action Plan Priority Species List. | |
| Tab | ole 5-1 | Summary of bat detector field survey effort and results at Kingdom Wind, 2009. | Community |
| Tab | le 5-2 | Summary of bat detector field survey effort and results through Sep Kingdom Community Wind, 2009. | |
| Tab | ole 5-3 | Distribution of detections by guild for detectors at Kingdom Commu 2009. | nity Wind, |



| -: | | | |
|----|----|----|----|
| | пı | ır | 20 |

- Figure 1-1 Project Area Location Map
- Figure 2-1 Ground clutter in horizontal mode (top) and vertical mode (bottom)
- Figure 2-2 Proper site selection can reduce ground clutter to the center of the radar screen (top), so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area (bottom)
- Figure 2-3 Detection range of the radar in vertical mode
- Figure 2-4 Nightly passage rates observed (error bars ± 1 SE) during Fall 2008 and Spring 2009 survey at Kingdom Community Wind, 2009.
- Figure 2-5 Hourly passage rates observed during Fall 2008 and Spring 2009 survey at Kingdom Community Wind, 2009.
- Figure 2-6 Mean flight direction for Fall 2008 and Spring 2009 season at Kingdom Community Wind, 2009.
- Figure 2-7 Mean nightly flight height of targets (error bars ± 1 SE) during Fall 2008 and Spring 2009 survey at Kingdom Community Wind, 2009.
- Figure 2-8 Percent of targets observed flying below a height of 125 m during Fall 2008 and Spring 2009 survey at Kingdom Community Wind, 2009.
- Figure 2-9 Hourly target flight height distribution during Fall 2008 and Spring 2009 survey at Kingdom Community Wind, 2009.
- Figure 3-1 Raptor flight position categories in relation to the topography of the Project area
- Figure 3-2 Daily totals of raptor species observed during Spring 2009 surveys at Kingdom Community Wind
- Figure 3-3 Number of individuals of species observed during Spring 2009 raptor surveys at Kingdom Community Wind
- Figure 3-4 Number of individuals observed per survey hour during Spring 2009 raptor surveys at Kingdom Community Wind
- Figure 3-5 Number of individuals of species observed within the Project boundary at flight height categories at Kingdom Community Wind, spring 2009
- Figure 3-6 Number of observations of flight behaviors observed at Kingdom Community Wind, Spring 2009
- Figure 5-1 North Tree detector, Kingdom Community Wind, 2009
- Figure 5-2 North Tower detector, Kingdom Community Wind, 2009
- Figure 5-3 Central Tree detector, Kingdom Community Wind, 2009
- Figure 5-4 South Tree detector, Kingdom Community Wind, 2009
- Figure 5-5 South Tower detector, Kingdom Community Wind, 2009
- Figure 5-6 Detection rate, as measured by the number of call files recorded per detectornight from April through October for five detectors at KCW, 2009
- Figure 5-7 Overall activity, as measured by the number of sequences recorded each month by five detectors at KWC, 2009
- Figure 5-8 Seasonal activity, as measured by the number of sequences recorded per month by five detectors at KWC, 2009
- Figure 5-9 Nightly activity, as measured by the number of sequences recorded during each hour after sunset by five detectors at KWC, 2009



| Figure 5-10 Figure 6-1 | Species composition across five detectors at KWC, 2009 Eastern small-footed Bat Project Area Location Map |
|---------------------------|---|
| Figure 6-2 | Eastern small-footed bat habitat observation routes |
| Figure 6-3 | The eastern slope of Mount Norris, Lowell, VT |
| Figure 6-4 | The eastern slope of Tillotson Peak, Lowell, VT, approximately 6 miles from the Project area |
| Figure 6-5 | The southern slope of Browns Ledges, Lowell, VT, approximately 5 miles from the Project area |
| Figure 6-6 | Hazen's Notch, looking west, Westfield, VT, approximately 7 miles from the Project area |

Appendices

Appendix A Radar Survey Data Tables
Appendix B Raptor Survey Data Tables

Appendix C Breeding Bird Survey Data Tables
Appendix D Acoustic Survey Data Tables

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^{*} This report was prepared by Stantec Consulting Services Inc. for Vermont Environmental Research Associates. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.



1.0 Introduction

Acting on behalf of Green Mountain Power (GMP), Vermont Environmental Research Associates (VERA) contracted Stantec Consulting Services Inc. (Stantec) to conduct ecological surveys at the proposed Kingdom Community Wind Project (KCW, Project) in Lowell, Vermont (Figure 1-1). These surveys were conducted to assess species composition and activity patterns of birds and bats in the area, in order to inform assessments of potential impacts of the proposed Project on birds and bats.

1.1 PROJECT BACKGROUND

As part of the wind facility planning process, VERA contracted Stantec to conduct the following ecological surveys in the Project area:

- Radar surveys were conducted during fall 2008 and spring 2009 to assess nocturnal migration patterns;
- A raptor survey was conducted during spring 2009 to assess diurnal raptor migration patterns;
- A breeding bird survey was conducted during summer 2009 to assess species composition and distribution of breeding birds, including Bicknell's thrush;
- An acoustic survey was conducted during spring, summer, and fall 2009 to assess bat activity patterns;
- An eastern small-footed bat habitat assessment was conducted in fall 2009 to identify potential habitat.

The scopes of these surveys were based on a combination of standard methods that have developed within the wind power industry for pre-construction surveys, and a review of the Vermont Agency of Natural Resources' (VANR) 2006 Draft *Guidelines for the Review and Evaluation of Potential Natural Resources Impacts from Utility-Scale Wind Energy Facilities in Vermont.* This is consistent with several other studies conducted throughout the northeast region of the United States. A specific acoustic survey work plan detailing site selection and study design was developed in collaboration with VANR biologist Scott Darling on April 10, 2009. and a specific breeding bird survey and Bicknell's thrush playback survey work plan was reviewed by VANR biologists John Austin and Everett Marshall at a joint VANR/KCW meeting held on May 29, 2009. This report summarizes the methods and results for each of the surveys completed at the Project area.



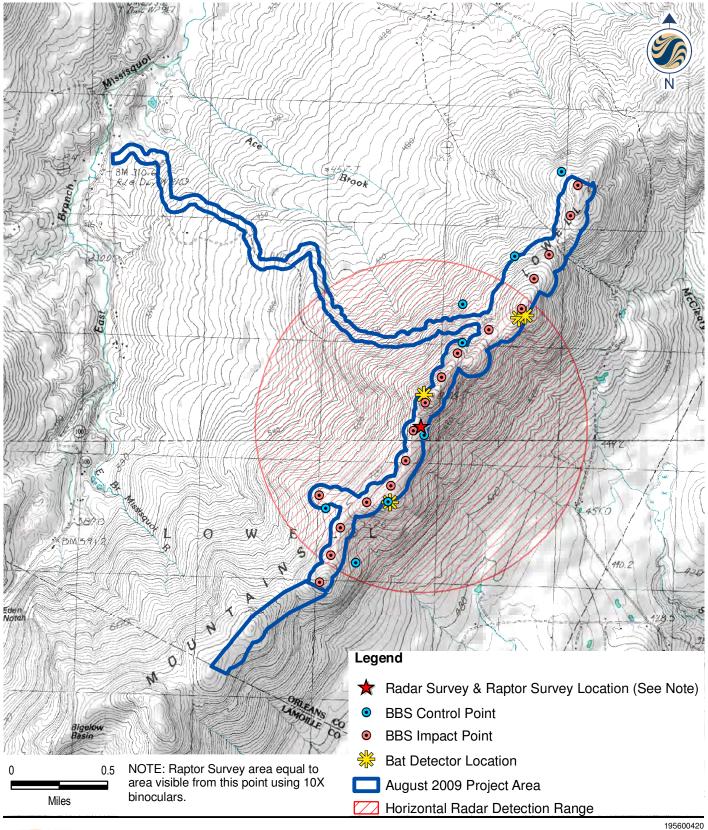
1.2 PROJECT AREA DESCRIPTION

The Project will support 20 to 24, 1.5 to 3.0 megawatt (MW) turbines mounted on tubular steel towers with an approximate height ranging from 410 feet (';125 meters [m]) to 443' (135 m) from ground level to the tip of a blade at its highest position.

The proposed Project area is located along approximately 3.2 miles (5.1 kilometers [km]) of the Lowell Mountains ridgeline, located in the town of Lowell, in southwestern Orleans County, Vermont (Figure 1-1). The Lowell Mountain range lies within the Northern Green Mountains biophysical region (Thompson and Sorenson 2000). This area of the Green Mountains can be divided into several distinct ranges; the Lowell Mountain range lies to the east of the main Green Mountain spine, and runs northeast to southwest from Lake Memphremagog to the town of Eden. The topography in this region is variable, ranging from 2,190' to 2,640' above sea level along the length of ridgeline on which wind turbines will be installed, to 1,148' to 1,476' along valley floors to the northwest and southeast. Several streams run down the steeper southeastern slope to the Black River, while streams on the shallower northwest slope converge on the East Branch of the Missisquoi River.

Habitats in the Project area are typical of higher elevation communities in the Northern Green Mountains biophysical region. The lowest elevations are dominated by Northern Hardwood Forest, with American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), and sugar maple (*Acer saccharum*) as the most common species. This gives way to Montane Yellow Birch-Red Spruce Forest, with Montane Spruce-Fir Forest evident at the highest elevations.

For the purposes of describing nocturnal migrant, raptor, breeding bird and bat activity near and within the Project area, the Project area refers to the proposed turbine area and access road as depicted in Figure 1-1. Stantec on-site field surveys (radar, raptor, breeding bird and acoustic surveys) had survey equipment or observation points located within the Project area (Figure 1-1). Each survey type sampled a unique amount of area surrounding the equipment or observation location.





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Client/Project

VERA Kingdom Community Wind Lowell Mountain

Lowell, Vermont

Figure No.

1-1 Title

Project Area Map

2/1/2010



2.0 Nocturnal Radar Survey

2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize fall 2008 and spring 2009 nocturnal migration patterns. Unlike migrating raptors, who take advantage of the warm, rising, daytime air of thermals during flight, the majority of North American passerines (songbirds) migrate at night. Raptors use soaring flight to take advantage of the laminar flow of air over the landscape, which creates updrafts along hillsides and ridgelines; whereas, passerines may have evolved the strategy of migrating at night to take advantage of more stable atmospheric conditions for their flapping flight (Kerlinger 1995). Waiting to migrate during the cooler nighttime temperatures may have also provided passerines the extra benefits of a more efficient method of regulating body temperature during more active, flapping flight and the reduction of predation risk while in flight (Alerstam 1990, Kerlinger 1995). Therefore, while raptor migration can be documented by visual daytime (diurnal) surveys, documenting the patterns of nocturnal migrants requires the use of radar or other non-visual technologies.

Marine surveillance radar has the ability to detect and track small animals, including birds, bats, and insects. Since flight speed can be determined, slow-flying insects can be removed from the sample. However, radar units cannot readily distinguish between birds and bats, and consequently, all animals observed are referred to as "targets." The majority of observed targets are assumed to be nocturnally migrating passerines, since there are many more species of birds than the nine species of bats occurring in the Northeast. The objective of radar surveys was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude, as well as to compare the results from fall 2008 and spring 2009 surveys.

2.2 SURVEY DESIGN

The radar survey was conducted in accordance with the 2006 Draft VANR Wind Power Guidelines. The radar unit was stationed near the center of the Project area, at the location where a 50 m meteorological (met) tower had been located. The same site was used in fall 2008 and spring 2009 surveys (Figure 1-1). This site afforded good sampling of the airspace within 0.75 nautical miles (1.4 kilometers [km], 4,557') of the site and was the most suitable location for radar equipment deployment. Effort was made to maximize the airspace sampled by elevating the antennae to approximately 8 m (26'), thus reducing the amount of the radar beam reflected back by surrounding vegetation and topography.



Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen were identified as "targets." The radar has an "echo trail" function which captures past echoes of flight trails, enabling determination of flight direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5') waveguide antenna. The antenna has a vertical beam width of 20 degrees (°; 10° above and below horizontal).

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas (Figure 2-1).

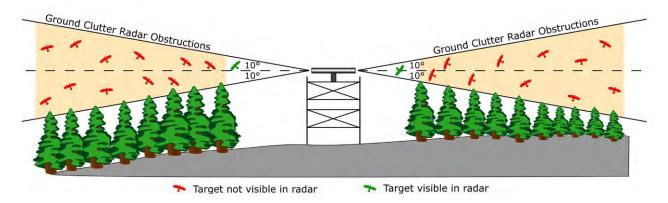
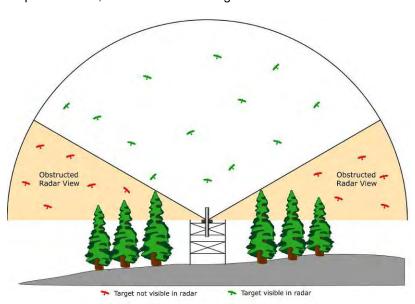


Figure 2-1. Ground clutter in horizontal mode (top) and vertical mode (bottom). Although the radar records three-dimensional space, it is translated by the radar screen into a two dimensional representation, which can cause targets to be obscured from view.





However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar. These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen – targets are indistinguishable from the "clutter" as represented on the radar screen (Figure 2-2). The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

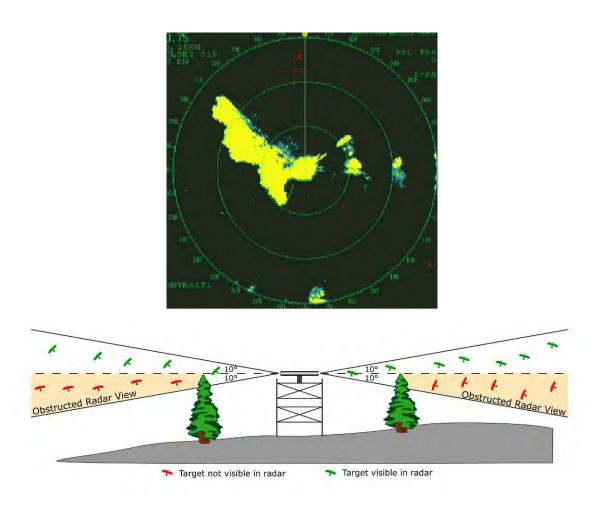


Figure 2-2. Proper site selection can reduce ground clutter to the center of the radar screen (top), so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area (bottom).

In accordance with Vermont pre-construction survey draft guidelines (VANR 2006), the fall survey collected data from sunset to sunrise over 20 nights between September 1 and October 15,2008, and the spring 2009 survey collected data from sunset to sunrise over 15 nights between April 15 and June 1, 2009. Because the anti-rain function of the radar must be turned



down to detect small targets, surveys could not be conducted during active rainfall. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the Project Site (Figure 2-2). By analyzing the echo trail, the flight direction and flight speed of targets can be determined.

In vertical mode, the radar unit is tilted 90° to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20° radar beam (Figure 2-3). Both modes of operation were used during each hour of sampling.

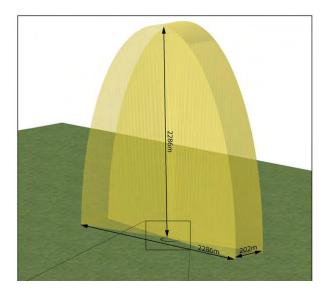


Figure 2-3. Detection range of the radar in vertical mode.

The radar was operated at a range of 1.4 km (4,557'). At this range, the echoes of small birds and bats can be easily detected, observed, and tracked. At greater ranges, larger birds can be detected but the echoes of small targets are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets.

2.3 DATA COLLECTION METHODS

2.3.1 Radar Data

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the



radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. A stratified random sample set was developed by randomly selecting 6 horizontal samples and 6 vertical samples per hour of survey. This sampling schedule allowed for randomization of sample collection and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

2.3.2 Weather Data

Temperature, relative humidity, wind speed, wind direction, and barometric pressure were recorded for the duration of the radar survey period at hourly intervals by a weather station (HOBO Micro Station H21-002) located at the radar station. Temperature and wind speed data were summarized by hour and by night for nights with radar data collection.

2.4 DATA ANALYSIS METHODS

2.4.1 Radar Data

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were exported to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently exported the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2® Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data. Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 135 m (443'), the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

2.4.2 Weather Data

The mean, maximum, and minimum temperature, mean and maximum wind speed, relative humidity, and barometric pressure were calculated for each survey night.



2.5 RESULTS

Radar surveys were conducted for 20 nights between September 10 and October 13, 2008, and for 15 nights between April 24 and May 29, 2009. (Appendix A, Tables 1 and 2). The radar view was impeded by a spur along the Lowell Mountain range to the northwest, and by the tree line along the southeastern slope (Figure 2-2). By elevating the radar 8 m above the ground, additional ground clutter was avoided.

2.5.1 Passage Rates

Fall 2008: The overall passage rate for the fall 2008 survey period was 356 targets per kilometer per hour (t/km/hr; Figure 2-4; also Appendix A, Table 3). Nightly passage rates varied from 12 t/km/hr on September 12, 2008 to 1372 t/km/h on October 4, 2008. For the entire season, passage rates were highest 2-4 hours past sunset and gradually declined through sunrise (Figure 2-5). Individual hourly passage rates ranged from 0 to 3051 t/km/hr (Appendix A, Table 3) and varied within and among nights.

Spring 2009: The overall passage rate for the spring 2009 survey period was 223 t/km/hr (Figure 2-4; also Appendix A, Table 4). Nightly passage rates varied from 8 t/km/hr on May 27, 2009 to 751 t/km/h on April 27, 2009. For the entire season, passage rates were highest two to three hours after sunset, and declined steadily thereafter (Figure 2-5). Individual hourly passage rates ranged from 0 to 889 t/km/hr (Appendix A, Table 4) and varied within and among nights.



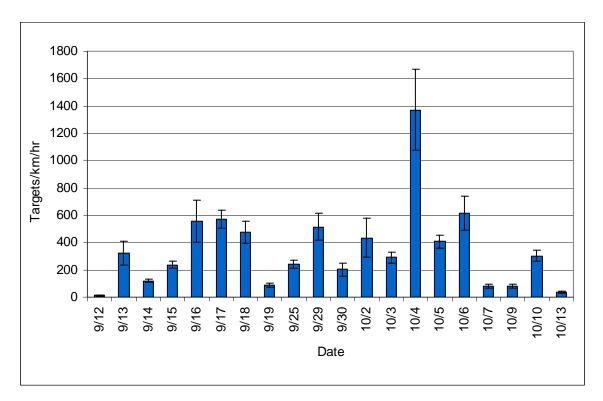
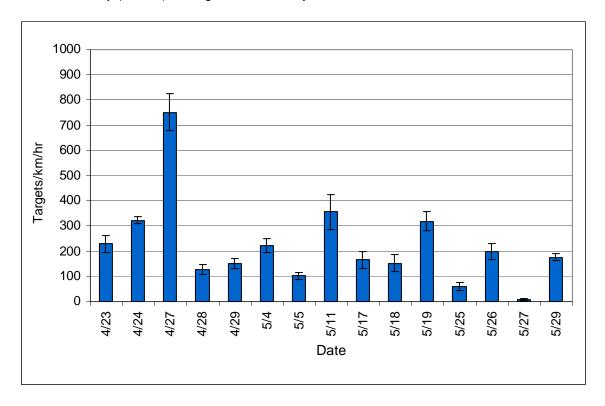


Figure 2-4. Nightly passage rates observed (error bars ± 1 SE) during Fall 2008 survey (top) and Spring 2009 survey (bottom) at Kingdom Community Wind. *Note the difference in Y-axis scales*.





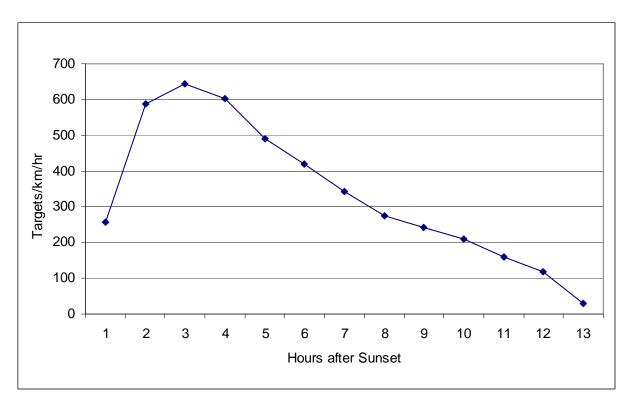
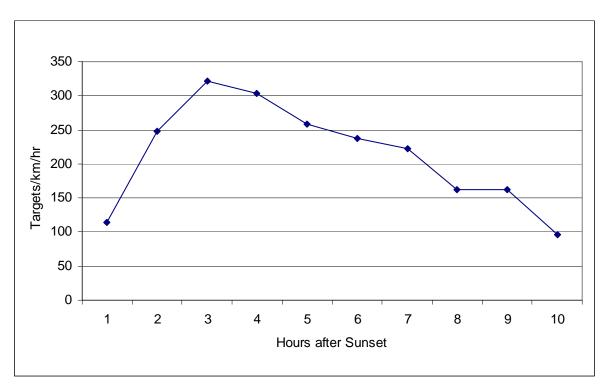


Figure 2-5. Hourly passage rates observed during Fall 2008 survey (top) and Spring 2009 survey (bottom) at Kingdom Community Wind. *Note the difference in Y-axis scales.*





2.5.2 Flight Direction

Mean flight direction through the Project area was $226^{\circ} \pm 60^{\circ}$ during the fall 2008 radar survey, and $80.5^{\circ} \pm 71.4^{\circ}$ during the spring 2009 radar survey (Figure 2-6, Appendix A, Table 5). This southwesterly direction in the fall and northeasterly direction in the spring was what would be expected during fall and spring migration.

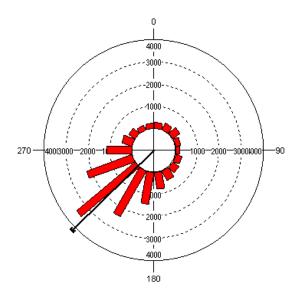
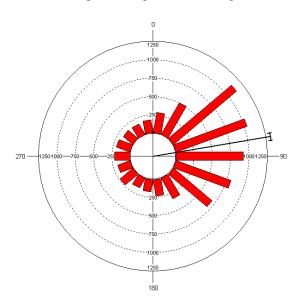


Figure 2-6. Mean flight direction for Fall 2008 season (top) and Spring 2009 season (bottom) at Kingdom Community Wind. The bracket along the margin of the histogram is the 95% confidence interval.





2.5.3 Flight Altitude

Fall 2008: The seasonal mean flight height of all targets was 350 m \pm 9 m (1148' \pm 30') above the radar site. The average nightly flight height ranged from 208 m \pm 9 m on October 3, 2008 to 534 m \pm 25 m on October 7, 2008 (Figure 2-7, Appendix A, Table 6). The percent of targets observed flying below 135 m (443') varied by night from 2 to 36 percent, with a seasonal average of 16 percent (Figure 2-8). Hourly flight heights were evenly distributed from the third through twelfth hour after sunset (Figure 2-9).

Spring 2009: The seasonal mean flight height of all targets was 298 ± 10 m ($978' \pm 32'$) above the radar site. The average nightly flight height ranged from 153 ± 28 m on April 28, 2009 to 517 ± 61 m on May 29, 2009 (Figure 2-7; Appendix A, Table 7). The percent of targets observed flying below 135 m (443') also varied by night from 12 to 52 percent, with a seasonal average of 22 percent (Figure 2-8). Hourly flight heights were evenly distributed from the second to the eighth hour after sunset and declined steadily thereafter (Figure 2-9).



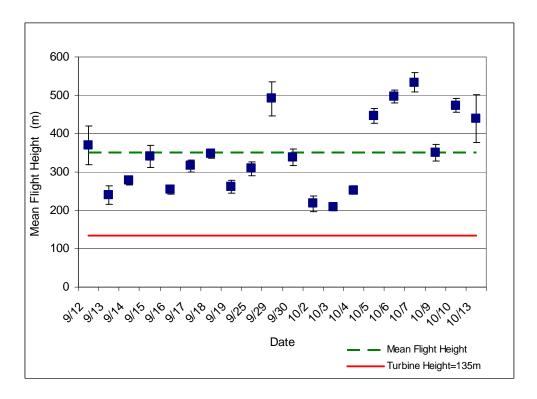
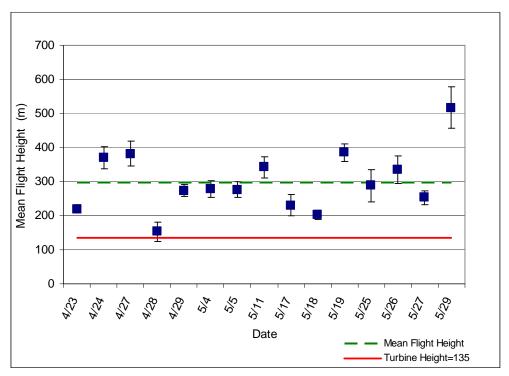


Figure 2-7. Mean nightly flight height of targets (error bars \pm 1 SE) during Fall 2008 survey (top) and Spring 2009 survey (bottom) at Kingdom Community Wind.





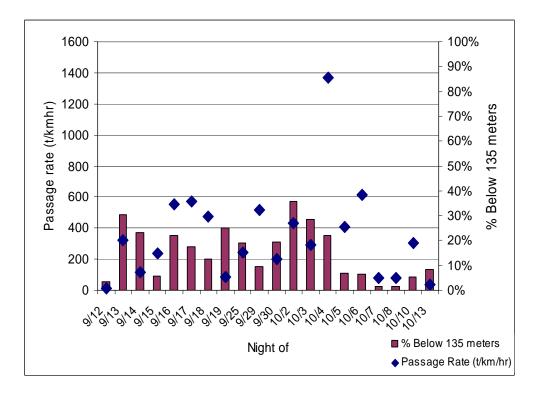
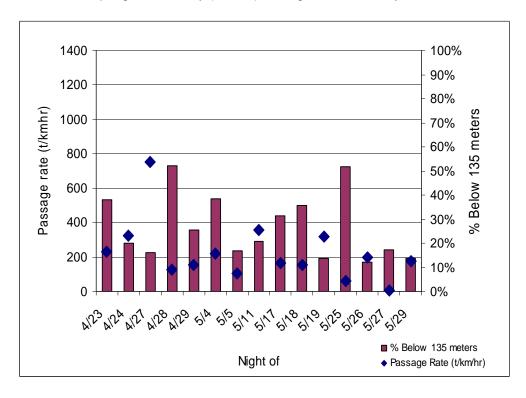


Figure 2-8. Percent of targets observed flying below a height of 135 m during Fall 2008 survey (top) and Spring 2009 survey (bottom) at Kingdom Community Wind.





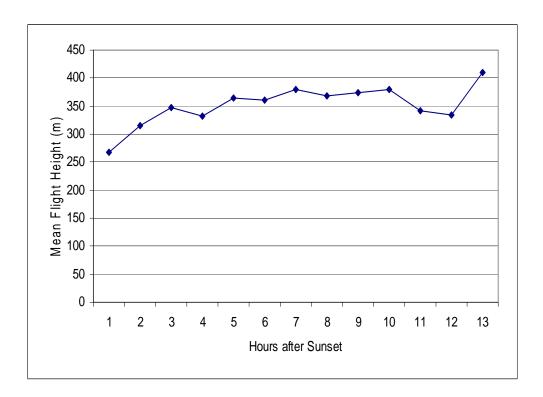
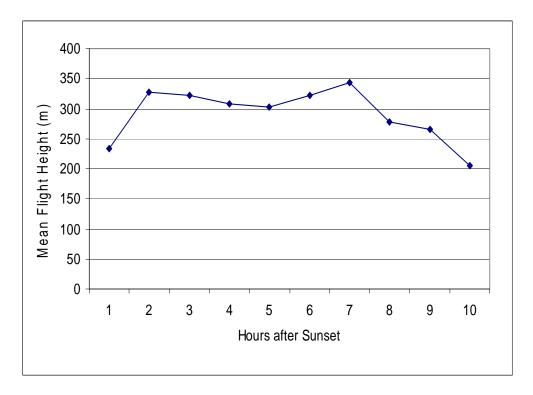


Figure 2-9. Hourly target flight height distribution during Fall 2008 survey (top) and Spring 2009 survey (bottom) at Kingdom Community Wind.





2.5.4 Weather Data

During the fall 2008 survey (September 12 to October 13), mean nightly wind speeds in the Project area varied between 2 and 7 m/s, with an overall mean of 4 m/s. Mean nightly temperatures varied between 1°C and 20°C, with an overall mean of 8°C (Appendix A, Table 1). The weather station anemometer malfunctioned on September 14 and did not collect data for the remainder of the survey. During the spring 2009 survey (April 23 to May 29), mean nightly wind speeds varied between 2 and 8 meters/second (m/s), with an overall mean of 4 m/s. Mean nightly temperatures varied between 1°C and 19°C, with an overall mean of 6°C (Appendix A, Table 2).

2.6 DISCUSSION

Both fall and spring radar surveys at the Project area documented patterns in nocturnal migration similar to those documented at most recent seasonal radar surveys. Spring radar results had lower passage rates with less night-to-night variation than results seen from the fall survey. Hourly passage rates from fall and spring surveys had similar trends, with passage rates peaking 2 to 3 hours after sunset during both surveys. Spring flight heights were lower than fall flight heights, and therefore the percent of targets flying below 125 m was higher.

The results are discussed here in the context of bird migration in order to place results into context. Currently, there is no reliable way to distinguish birds from bats during radar data analysis, so results refer only to "targets." However, given that the number of potential bird species migrating across the Project area far outweigh the nine species of bats known to occur in Vermont, it is likely that the pool of observed targets is composed of a higher percentage of birds than bats.

Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). The radar surveys along the Lowell Mountain range documented passage rates that were highly variable, ranging from 12 to 1372 t/km/hr in fall 2008 and 8 to 751 t/km/hr in spring 2009. The survey night of May 27, 2009 provides an example of the potential effects of weather patterns on passage rates. This survey night had the lowest average passage rate of the spring season (0 t/km/hr). During the May 27 survey night, the mean nightly temperature was only 8°C, and several hours were unable to be analyzed because of rain; but of those that could, the hourly passage rates (ranging from 0 to 7 t/km/hr) were low in comparison with nights with more favorable conditions. A night, such as that of April 27, 2009 which documented the highest average passage rate (751 t/km/hr) provides the comparison: conditions that night (a mean nightly temperature of 19°C and no rain) were presumably more suitable for migration, which is reflected by higher hourly passage rates ranging from 346 to 889 t/km/hr. Large migration events are generally thought to occur on mild nights with calm winds or



winds from an advantageous direction for migration. Therefore, because the radar site remained in the same configuration during both seasons of survey, variability in passage rates indicates that nocturnal migration was pulsed, presumably related to seasonal timing and regional weather conditions.

Data from regional surveys using similar methods and equipment conducted within the last several years are rapidly becoming available (Appendix A, Table 8). These other studies provide an opportunity to compare the results from Lowell Mountain to other projects in the region. The emerging body of studies characterizing nocturnal migration shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of several hundred meters or more above the level of the radar unit (Appendix A, Table 8). Comparison of flight altitudes between survey sites as measured by radar is generally less influenced by site characteristics, as the main portion of the radar beam is directed skyward and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. Comparison of passage rates between radar surveys along Lowell Mountain range and similar surveys conducted at other sites must be done with caution, however, as differences in passage rates could be due, in large part, to differences in radar view between sites. In particular, the topography, local landscape conditions, and vegetation surrounding a radar survey location can dramatically influence the ability of any radar unit to detect targets and the subsequent calculation of passage rate. These differences should be recognized as one of the more significant limiting factors in making direct site-to-site comparisons in passage rates. In addition, year-to-year variation in species population size and weather conditions may also contribute to variation in passage rates.

Nevertheless, it can be useful to put radar survey results in context with other studies while remaining mindful of potential comparison pitfalls. Both nightly and seasonal passage rates and flight heights recorded at Lowell Mountain fall in the middle of the range of values observed at other studies in the area (Appendix A, Table 8).

Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and mountain ranges. This has been documented for diurnally migrating birds, such as raptors, but is not as well established for nocturnally migrating birds (Sielman *et al.* 1981; Bingman 1980; Bingman *et al.* 1982; Bruderer and Jenni 1990; Richardson 1998; Fortin *et al.* 1999; Williams *et al.* 2001; Diehl *et al.* 2003). However, studies suggesting that night-migrating birds are influenced by topography have typically been conducted in areas of steep and abrupt topography, such as the most rugged areas of the northern Appalachians and the Alps; in other words, areas unlike the low-elevation foothills of the Green Mountains. No evidence of target concentration was observed in either the fall 2008 radar survey or the spring 2009 survey. Targets were observed in all areas of the radar detection range and were evenly distributed around the radar, indicating that concentration to any one part of the Project area was not occurring.

Fall and spring radar surveys at the Project area documented patterns in nocturnal migration similar to those documented at most recent fall radar surveys. Analysis of flight direction and



dispersion of targets relative to the surrounding topography in both seasons of survey indicates that nocturnal migration in the Project area can be characterized as "broad-front", rather than concentrated in narrow corridors or funneled based on topographic features. Additionally, the flight height of targets indicates that the vast majority of nocturnal migration in the area occurs above the height of the proposed wind turbines. This type of broad-front movement, particularly in conjunction with the high observed flight heights, could minimize the potential for nocturnal migrants to collide with proposed turbines in the Project area. As a result, we would expect post-construction impacts to be similar to other projects in the region.



3.0 Diurnal Raptor Survey

3.1 INTRODUCTION

In the eastern United States,, migrating raptors tend to concentrate along linear mountain ridgelines which provide 'leading lines' for migrants (Kellogg 2007). Updrafts are formed along the side slopes of ridges which raptors use in order to fly long distances with minimal exertion (Berthold 2001). Soaring raptors also use thermals, upwellings of warm air caused by sunlight as it heats the ground surface, to gain altitude during migration (Sibley 2001). Once soaring migrants are high in a thermal, they will glide gradually downward in the direction of their migration while looking to take advantage of another thermal for lift (Sibley 2001). In the Eastern Continental Hawk Flyway, raptor migration also tends to concentrate along the shores of large bodies of water including lakes and the Atlantic Coast, as many species of raptor avoid crossing large bodies of water (Kellogg 2007). Raptor migration is facilitated by tail winds (winds aligned with the preferred direction of travel), which "push" migrating raptors forward (Bildstien 2006); however, some raptors will fly in light or moderate headwinds.

Outside of previous and ongoing studies at California's Altamont Pass, peer-reviewed studies of mortality at operating wind farms have consistently documented exceptionally low raptor mortality rates throughout North America (The Wildlife Society, 2007). However, it is also true that less is known about avian migration patterns in Vermont. It is currently thought that raptors migrate on a broad front through the region; however, it is known that topographic features can influence raptor migration patterns. The Project is located along a linear ridgeline; therefore, the spring 2009 raptor migration survey was performed to establish baseline data for raptor migration activity in the vicinity of the Project area. It was the purpose of the spring 2009 raptor survey to sample migration activity at a central and prominent location within the Project; data collected included species that occur in the vicinity of the Project, specific flights heights, flight path locations, and other flight behaviors of raptors within or in the visible vicinity of the Project.

3.2 DATA COLLECTION METHODS

3.2.1 Field Surveys

Survey methods and objectives were based on the VANR 2006 Draft Vermont Wind Power Guidelines and Hawk Migration Association of North America (HMANA) methods (HMANA 2007). Diurnal raptor surveys targeted the peak spring migration period for many species of raptors, which usually occurs between April 1 and May 31. Surveys targeted 10 days including days following the passage of weather fronts bringing favorable weather, days with decent thermal development, and days with predominantly southerly winds. Additionally, days with headwinds were sampled as some raptors' flight behaviors differ in moderate to strong headwinds.



Surveys were conducted from 9 am to 4 pm or 5 pm, during the peak hours of thermal development and raptor movement. During surveys, observers scanned the sky and surrounding landscape with binoculars or a spotting scope. Hourly weather observations including wind speed and direction, temperature, sky conditions, percent cloud cover, and relative cloud height and type were recorded. Detailed information for each observation was recorded on datasheets and Project area maps, including:

- Observation date and time;
- Species, number of individuals, and age (if possible);
- Whether the raptor occurred within the Project boundary (as depicted in Figure 3-1);
- The flight positions of each bird in relation to topography of the area;
- The flight height (above ground) of each bird (within each different topographical flight position);
- The specific flight behaviors of each bird;
- The general flight direction of each bird; and
- If the bird was actively migrating as well as other notes describing the general activity of each bird.

Topographical flight positions were summarized into categories that describe the landscape surrounding the observation site (these positions apply to birds observed both within as well as outside of the Project boundary): A1) parallel to or along ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (Figure 3-1). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.



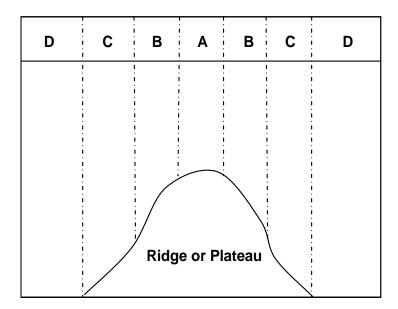


Figure 3-1. Raptor flight position categories in relation to the topography of the Project area.

Nearby objects with known heights, such as the radar platform, portable bat detector towers, and trees were used to gauge flight height.

Flight behaviors where categorized as: circle soaring, linear soaring (straight-line soaring or slow gliding in a 'thermal street' formed between updrafts), gliding (with wings partially closed and bent wrists), powered flight (flapping wings), banking (breaking with fully extended wings and tail fanned), diving (wings partially to mostly closed while in descent), kiting (using wind current to kite with partially closed wings and tail), hovering (maintaining a stationary altitude with some flapping and fanned tail while hunting and looking downward), aerial feeding (eating prey in flight while in a soar or slow glide), aerial hunting low over the ground, aerial display (territorial or courtship aerial display), or perched. These behaviors among others were used to determine whether or not birds were actively migrating.

Birds that flew too rapidly or were too far away to accurately identify were recorded to genus if possible; otherwise, as an unidentified raptor. Priority was given to raptor observations; however, observers collected incidental data for other avian species observed, including passerines and water birds.

3.2.2 Survey Location

Spring 2009 raptor surveys were conducted from an old meteorological (met) tower clearing at a prominent and central location on the ridgeline (Figure 1-1). Surveys were conducted from the top of a platform used for the spring nocturnal migration radar surveys (8 m; 26'). The site provided good views in all directions, but was somewhat restricted to the northwest by trees.



The Project area boundary used during the spring 2009 raptor survey is outlined in Figure 1-1. The area surveyed was equal to the area visible, using binoculars with 10x magnification, from an observer standing on the radar platform.

3.3 DATA ANALYSIS METHODS

The raptor observation data was summarized by survey day and for the entire survey period. Analysis included a summary of:

- The total number of individuals per species observed each survey day, and for the entire survey period;
- Daily passage rates (raptors per hour) calculated for each survey day, as well as for the entire survey period;
- · Hourly observation totals per species;
- The percentage of raptors within each topographical flight position category;
- The average minimum flight height of raptors within each topographical flight position category;
- The percentage of all raptors that occurred within the Project boundary;
- Flight heights categorized as less than or greater than 135 m (443') above ground for all raptors observed within the Project boundary;
- The percentage of raptors believed to be actively migrating; and
- A summary of the flight behaviors of all raptors observed.

Results were compared to other baseline data from publicly available raptor studies conducted recently at similar wind development sites in the region.

3.4 RESULTS

Spring raptor migration surveys were conducted on 10 days from April 15 to June 1, 2009, resulting in a total of 74 survey hours. Surveys were conducted from 9 am to 5 pm (April 15, 16, 24, and 25) or 9 am to 4 pm (May 5, 15, 21, 22, 26, and June 1). Winds were predominantly from the northwest during three survey days (4/16/2009, 5/15/2009, 6/1/09), winds were variable during three survey days (4/15/2009, 4/25/2009, 5/26/2009), from the west during three survey days (4/24/2009, 5/21/2009, 5/22/2009) , and predominantly from the southeast during one survey day (5/5/2009). Sky conditions were largely clear to partly cloudy during the surveys; however, on June 1, there were periods of low fog during the morning when visibility was restricted

A total of 134 raptors were observed during the spring 2009 raptor survey period. The seasonal passage rate at The Project was 1.81 raptors per survey hour (raptors/hour). The survey day with the highest passage rate (4.5 raptors/hour; Appendix B Table 1) occurred on April 25 when



wind direction was variable, wind speeds ranged from calm with gusts up to 20 mph (30 kilometers per hour [kph]), and sky conditions were mostly clear to scattered clouds. Daily count totals ranged from 2 to 36 raptors (Figure 3-2, Appendix B Table 1).

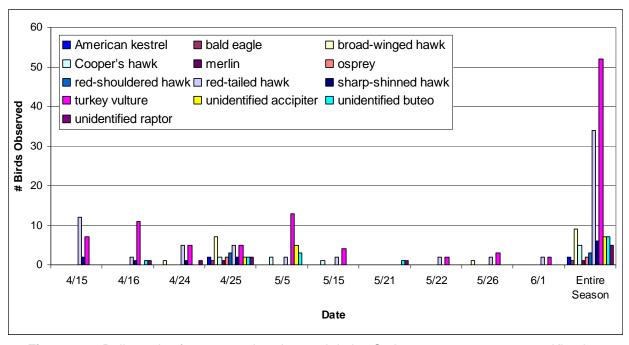


Figure 3-2. Daily totals of raptor species observed during Spring 2009 raptor surveys at Kingdom Community Wind.

There were 13 different species of raptor observed during the spring 2009 raptor survey (including unidentified accipiters, unidentified buteos, and unidentified raptors). The species with the greatest number of observations was turkey vulture (*Cathartes aura*) (n=52; 39 %), followed by red-tailed hawk (*Buteo jamaicensis*) (n=34; 25 %) (Figure 3-3; Appendix B Table 1).



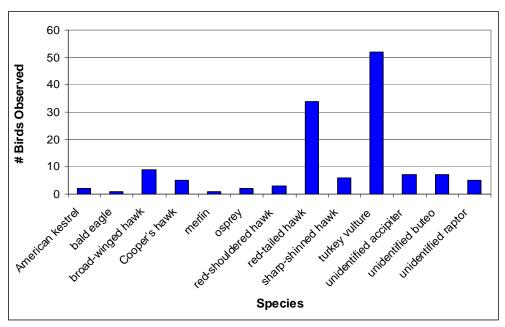


Figure 3-3. Number of individuals of species observed during Spring 2009 raptor surveys at Kingdom Community Wind.

On a daily basis, the majority of observations occurred between 10 am and 12 pm, then peaked again between 3 and 4 pm (Figure 3-4, Appendix B Table 2).

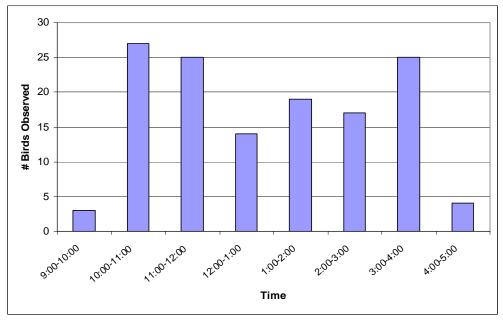


Figure 3-4. Number of individuals observed per survey hour during Spring 2009 raptor surveys at Kingdom Community Wind.



The majority of raptors observed in the different flight positions occurred above and along the ridgelines in the vicinity of the Project (35%), followed by flight positions over the upper slopes in the vicinity of the Project (30%) (Table 3-1). Note that some birds occurred in multiple flight position categories as they traveled in the vicinity of the Project; therefore, there are more observations of flight positions than there were total birds observed.

Table 3-1. Number of observations and average flight heights for each position category at the Kingdom Community Wind Project, Spring 2009

| | , , , , | | | | | |
|---|---|-------------------------|--|----------------------|----------------------|----------------|
| | A1) flight along or parallel to ridge | A2) crossed ridge | A3) flight crossed depression or saddle | B) upper slope | C) lower slope | D) over valley |
| No. of position observations (n=176; greater than no. individuals) | 61 | 27 | 5 | 52 | 24 | 7 |
| Average minimum flight height (m) | 115.5 | 75.6 | 240.0 | 128.1 | 243.8 | 414.3 |

Of the 134 total raptors observed, 118 raptors (88%) occurred within the Project boundary as it is defined by Figure 1-1 (Figure 3-5, Appendix B Table 3). Among those 118 birds, 69 percent (n=82) occurred below 135 m, the height of the proposed turbines, for at least a portion of their flight through the Project boundary.

Of the 134 total raptors observed, 33 percent (n=44) were believed to be actively migrating based on their direct flight paths and/or general migratory direction; 32 percent (n=43) were not believed to be actively migrating and may have been seasonally local birds or birds stopping-over during migration; for the remaining 35 percent (n=47), it was unknown if they were actively migrating or not. Species suspected to be seasonally local birds or birds that may have stopped over in the vicinity of the Project during migration include American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), red-tailed hawk, sharp-shinned hawk (*Accipiter striatus*), turkey vulture, unidentified accipiter, unidentified buteo, and unidentified raptor (Figure 3-5).



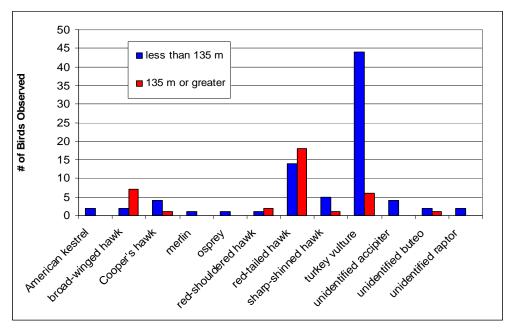


Figure 3-5. Number of individuals of species observed within the Project boundary at flight height categories at Kingdom Community Wind, Spring 2009.

The raptor flight behaviors observed in the Project area are summarized in Figure 3-6 below. Note that some birds exhibited multiple flight behaviors as they traveled in the vicinity of the Project; therefore, there are more observations of flight behaviors than there were total birds observed. Raptors were most often observed exhibiting gliding behavior (n=50), followed by circle soaring (n=38). Species that were engaged in low aerial hunting (suggesting they were stopover birds or seasonally local birds) include turkey vulture, sharp-shinned hawk, red-tailed hawk, merlin, and an unidentified raptor. Birds observed perched in the Project area included red-tailed hawk and an unidentified accipiter.



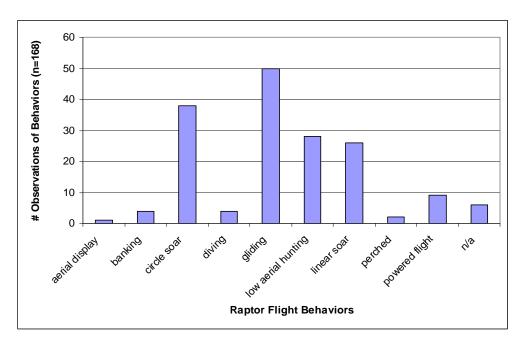


Figure 3-6. Number of observations of flight behaviors observed at Kingdom Community Wind, Spring 2009.

3.4.1 Species of Conservation Concern

One state endangered raptor species (bald eagle [Haliaeetus leucocephalus]) was observed outside the Project area. This individual was observed on April 25, south/southwest of the Project area boundary, circle soaring at an approximate height of 500 m (1640 ft) above ground level. Stantec biologists used a radar recording of the flight to estimate the eagle's minimum distance to the Project area boundary, which was 1,060 m (3477').

3.4.2 Incidental Bird Observations

A total of 19 different non-raptor avian species were observed incidentally during the spring 2009 surveys (Table 3-2). None of these species are designated as state endangered or threatened, or are recognized as a species of special concern.



| Table 3-2. Non-raptor avian species observed incidentally during raptor surveys at Kingdom Community Wind, Spring 2009 |
|---|
| American crow |
| American robin |
| black-capped chickadee |
| blue jay |
| blackpoll warbler |
| black-throated blue warbler |
| common raven |
| dark-eyed junco |
| golden-crowned kinglet |
| hairy woodpecker |
| hermit thrush |
| magnolia warbler |
| Nashville warbler |
| red-breasted nuthatch |
| ruby-throated hummingbird |
| winter wren |
| white-throated sparrow |
| yellow-bellied sapsucker |
| yellow-rumped warbler |

3.5 DISCUSSION

There were 13 different species of raptor observed during the spring 2009 surveys (including unidentified accipiter, unidentified buteo, and unidentified raptor). Turkey vultures were most often observed, and some individuals were suspected to be seasonally local birds. One state endangered species, a bald eagle, was observed outside the Project area. The majority of birds observed during the spring 2009 surveys at KCW were seen within the Project boundary; however, the observation location was within the Project and smaller, lighter colored raptors occurring at greater distances from the observer would be more difficult to detect. The majority of flight positions in the vicinity of the Project occurred above and along ridges, as well as over upper slopes of ridges.

A total of 134 birds were observed resulting in a seasonal passage rate of 1.81 raptors/hour. For those birds that occurred at some location within the Project boundary, 69 percent were below 135 m, the proposed maximum height of the turbines. The results of the spring 2009 surveys at The Project are comparable to other publicly-available baseline raptor surveys (Appendix B Table 4): in Sheffield, VT, a spring raptor survey documented 1.6 raptors/hour. Overall spring passage rates among available baseline studies in the East have ranged from 0.1 to 6.25 raptors/hour; and the percentage of raptors observed below the proposed turbine height(s) have ranged from 3 to 94.7 percent (Appendix B Table 4).



Despite often flying at heights within or near the rotor swept zone, studies at modern wind facilities have documented high rates of collision avoidance behavior in raptors (Whitfield and Madders 2006, Chamberlain *et al.* 2006). Variations in flight heights among sites, and among survey days at a single site, are due to variable weather conditions and the particular flight behaviors of different raptor species. Typically, accipiters and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. Buteos tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors (accipiters in particular) typically fly lower than usual during windy or inclement conditions. Local birds may fly at lower altitudes while making small scale movements between foraging locations (Barrios and Rodriguez, 2004).

As most raptors are diurnal, raptors may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines. The occurrence of some raptors within the zone of the proposed rotor blades increases the potential for migrating raptors to come into the vicinity of the turbines; however, raptor mortality in the United States, outside of California, has been documented to be relatively low. For example, mortality rates found at wind developments, outside of Altamont Pass in California, have documented 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). According to a technical review of wind power impacts by The Wildlife Society (2007), there is a mean raptor mortality rate of 0.03 raptors per turbine per year at operating wind farms. Several recent studies, conducted in the U.S., have documented low raptor mortality with fewer than 20 raptor fatalities reported at more than a dozen sites combined (Osborn *et al.* 2000, Johnson *et al.* 2002, Kerlinger 2002, Young *et al.* 2003, Erickson *et al.* 2000, Kerlinger 2006, Erickson *et al.* 2007, Jain *et al.* 2007, Jain *et al.* 2008, Stantec 2008j, Stantec 2009).

The flight paths of raptors observed at the Project varied between survey dates and were influenced by varying wind direction and weather. During raptor migration, flight pathways and flight heights along ridges, side slopes, and across valleys may vary seasonally, daily, or hourly. Raptors may shift and use different ridgelines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration paths as well as flight heights. Wind strongly affects the propensity of birds to congregate along 'leading lines' or topographic features (Richardson 1998). Wind, air temperature, and cloud cover influence the development of updrafts and thermals used by raptors while making long-distance flights.

The relatively low passage rate observed at the Project during the spring 2009 survey suggests that raptor migration activity through the Project area is not concentrated; rather, raptors move on a broad-fronted migration pattern through the area. The percent of raptors that occurred at heights below the proposed rotor zone within the Project boundary was low in comparison to the majority of other available studies conducted in the east. There may be some annual variation in the seasonal passage rates and flight heights at KCW due to variability in annual populations and weather conditions. However, there is no reason to suspect that the spring 2009 raptor survey results are atypical.



Low passage rates, low percentage of raptors observed at heights below the proposed rotor zone, presumed broad-front migration patterns, and studies documenting high raptor collision avoidance behaviors could indicate reduced risk to raptors. However, currently there is no clear relationship between pre-construction and post-construction data for the prediction of raptor collision risk at wind sites. That is, at existing wind farms, the passage rates and percentages of birds below turbine height determined during pre-construction surveys have not been directly correlated to the actual number of raptors that have been found during post-construction mortality studies. Therefore pre-construction raptor studies should be viewed as providing baseline data regarding the species of raptor that occur in the area and the general flight behaviors of raptors traveling through the area.



4.0 Breeding Bird Surveys

4.1 INTRODUCTION

Stantec conducted a breeding bird survey at the Project during summer 2009. The 2009 survey provides baseline data of species presence in the Project area, their abundance, as well as the community structures among the different habitats present at the Project. The objective of the survey was to determine the species composition, abundance, diversity, and distribution of all breeding bird species acoustically or visually detected in the Project area. The survey additionally focused effort on documenting the potential occurrence of Bicknell's thrush (*Catharus bicknelli*; species of state conservation concern), state or federally threatened or endangered species, other species of conservation concern, and species included as priority species under the Vermont Wildlife Action Plan (2005) priority species list.

The scope of this survey was based on a combination of standard methods that have developed within the wind power industry for pre-construction surveys, and a review of the Vermont Agency of Natural Resources' (VANR) 2006 Draft *Guidelines for the Review and Evaluation of Potential Natural Resources Impacts from Utility-Scale Wind Energy Facilities in Vermont.*Breeding bird survey methods and Bicknell's thrush playback survey methods were also based on United States Geological Survey (USGS) North American Breeding Bird Survey and Vermont Center for Ecostudies (VCE) survey techniques, as well as the United States Fish and Wildlife Service (USFWS) Breeding Bird Survey methodology (Sauer *et al.* 2000). A specific breeding bird survey and Bicknell's thrush playback survey work plan was reviewed by VANR biologists John Austin and Everett Marshall at a joint VANR/KCW meeting held on May 29, 2009.

4.2 DATA COLLECTION METHODS

4.2.1 Breeding Bird Survey Point Counts

Stantec conducted two rounds of point count surveys at The Project, the first between June 10 and 12, 2009. The second round was conducted between June 21 and 23, 2009 due to inclement weather preventing an earlier survey. Surveys generally started 15 minutes prior to sunrise and ended before 10:30 am (based on weather) on days with suitably clear weather, with mild temperatures, and when rain or wind would not inhibit the detection of birds. GPS location, time, weather, habitat, species, number of individuals, and other behavioral notes were recorded during each survey point. Point count locations were established with GPS equipment at 17 locations along the ridgeline, as well as at 8 control locations in similar habitats outside of areas that would be impacted by construction, based upon the August 2009 conceptual project plan (Figure 1-1).



During surveys, observers oriented themselves toward the north in order to record the general location of birds onto circle sketches with direction quadrants. Point count sample periods were broken into three periods: the first three minutes, the following two minutes, and the final five minutes. For the duration of the 10-minute count surveys, the species and the number of individuals occurring between less than 50 m, greater than 50 m, or flying overhead, were recorded in the period during which they were first seen or heard. During each consecutive time period, observers would determine the location of previously recorded birds and track any movements within the count circle in order to avoid recounting birds. Other notes related to breeding behavior, weather conditions, and habitat descriptions were recorded. When possible, observers made digital recordings of rare or unusual birds. Observations of birds made before and after the point count timeframes were recorded separately as incidental observations.

4.2.2 Bicknell's Thrush Playback Survey

After each 10 minute point count survey at all 25 point count locations, observers played digital recordings of Bicknell's thrush vocalizations through a speaker for one minute and listened for the presence of Bicknell's thrush for 2 minutes. Any observations of birds made before and after the point count timeframes were recorded separately as incidental observations.

4.2.3 Data Summary and Analysis

Habitat types were classified based on the prevalent habitat found at each point count. Habitats that share similar characteristics were grouped wherever possible for statistical analysis purposes. For example, deciduous forest habitat included areas that were either densely vegetated, relatively open and stunted, and/or had sparse occurrences of conifer species. The habitat types surveyed among the turbine points included deciduous forest, conifer forest, and deciduous/conifer mixed forest. The habitat surveyed among the control points included deciduous forest and mixed forest.

Quantitative data collected during point counts were used to calculate the species richness, relative abundance, community diversity, and frequency of breeding birds within the available habitats of the Project area.

- Species richness (SR) is the total number of species that are detected at a specific point, within a habitat classification, or across the Project area.
- In order to quantify the number of individuals of a species in the Project area and within the different habitat types, relative abundance (RA) was calculated. RA measures the number of individuals of a species within a habitat classification or across the Project area, and takes into account the number of times each point is surveyed and the number of points per habitat, or per Project area.
- Frequency (Fr) of occurrence, expressed as a percentage, measures the number of points within a habitat type, or across the Project area, where a particular species is detected.



 The Shannon Diversity Index (SDI) is a measure of species diversity in a community or habitat. SDI can provide more information about community composition than species richness alone because it takes into account relative abundance and evenness of species. It indicates not only the number of species, but also how abundance is distributed among all the species in the community or habitat.

Species recorded as beyond 100 m from the observer, as flyovers, or birds detected incidentally were not included in the statistical analysis for relative abundance, species frequency, or community diversity due to the probability that they were not breeding within the direct vicinity of the point count location; however, these data were used to determine overall species richness and the total number of birds observed.

4.3 RESULTS

The first round of breeding bird point count surveys and playback surveys was conducted between June 10 and 12 and the second round was conducted between June 21 and 23. Surveyors aimed to conduct surveys during days when weather conditions were optimal and had no adverse affect on bird detection; however, several survey days had periods of marginal weather. June 10, 11, 21, and 22 had periods of fog and June 10, 11, 12, and 21 had periods of drizzle. Wind conditions were predominantly calm to 19 kph (0 to 12 miles per hour [mph]); wind speeds only exceeded this range during one survey on June 22. Temperatures during the surveys ranged from 12 to 17°C (54 to 63°F).

4.3.1 BBS Point Counts

Breeding bird surveys sampled a total of 25 point counts: 17 impact points and 8 control points. Each of the points was surveyed twice, resulting in observations of 301 individual birds. Thirty-five species were detected during point count surveys, and one additional species was detected incidentally between surveys resulting in a total of 36 species detected within the Project area. Thirty-three species were detected at impact points and 22 species were detected at control points. The mean overall relative abundance of birds for the entire survey period was 3.71 birds per impact point and 4.13 birds per control point. Species richness ranged from 2 to 9 for individual impact points and from 3 to 9 for individual control points. Sixty-four percent of birds (n=126) at impact points and 62 percent of birds (n=66) at control points were detected within 100 meters of the observer (Appendix C, Tables 1A-B). Twenty-seven birds were observed incidentally between point count surveys, but were not included in the analysis of species richness, abundance, or frequency for each habitat due to the possibility that they were not breeding within the point's survey area at the time of detection.

The species most commonly observed among the 17 impact points included the white-throated sparrow (*Zonotrichia albicollis*) (n=30), black-throated blue warbler (*Dendroica caerulescens*) (n=21), and dark-eyed junco (*Junco hyemalis*) (n=21). The species most commonly observed among the 8 control points included the black-throated green warbler (*Dendroica virens*) (n=17), ovenbird (*Seiurus aurocapillus*) (n=13), and white-throated sparrow (n=12) (Appendix C, Tables 1A-B).



Point count data were analyzed to determine species richness, diversity, relative abundances and frequencies of birds in each habitat type surveyed, which included deciduous forest, conifer forest, and mixed forest among the impact points; and deciduous forest and mixed forest among the control points. Tables 4-1 and 4-2 summarize the results of point count surveys by habitat type, listing the number of habitat types classified in the BBS surveys, the numbers of points surveyed in each habitat, the species richness, mean relative abundance, and Shannon Diversity Index.

| Table 4-1. Summary of breeding bird point count results by habitat type – Impact points, Summer 2009 | | | | | | | | |
|---|--|-----|----|------|------|--|--|--|
| Habitat Type | # BBS Observed Observed Within 100 m # Birds Observed Species Richness Richness Abundance Signature Abundance | | | | | | | |
| Deciduous forest | 8 | 46 | 16 | 2.88 | 2.50 | | | |
| Conifer forest | 6 | 57 | 18 | 4.75 | 2.62 | | | |
| Deciduous/conifer mixed forest | 3 | 23 | 12 | 3.83 | 2.24 | | | |
| Combined | 17 | 126 | 27 | 3.71 | 2.87 | | | |

| Table 4-2. Summary of breeding bird point count results by habitat type – Control points, Summer 2009 | | | | | | | | |
|--|---|----|----|------|------|--|--|--|
| Habitat Type # BBS Observed Note of the points of the poin | | | | | | | | |
| Deciduous forest | 5 | 32 | 12 | 3.20 | 2.17 | | | |
| Deciduous/conifer mixed forest | 3 | 34 | 12 | 5.67 | 2.29 | | | |
| Combined 8 66 20 4.13 2.67 | | | | | | | | |

The impact points had a greater combined species richness and diversity than the control points, and the control points had a greater mean relative abundance than the impact points. Among impact points, the conifer forest habitat had the greatest species richness. Conifer habitat was not sampled among the control points, and both habitats sampled among control points had the same species richness. The conifer forest habitat had the greatest relative abundance and diversity index among impact points, and the mixed forest had the greatest relative abundance and diversity index among control points.



4.3.2 Habitat Types Documented in Project Area

Following are the values for species richness, relative abundances and frequencies of the most commonly detected species in the habitat types surveyed at Kingdom, which are detailed in Appendix C, Table 2A-B.

4.3.2.1 Deciduous forest

Deciduous forest was sampled among 8 impact points and 5 control points. The species richness (SR) among impact points was 16 and ranged from 2 to 7 species per point, and the species richness among control points was 12 and ranged from 3 to 5 species per point. The species with the greatest relative abundances (RA) among impact points included the black-throated blue warbler (RA= 0.69), black-throated green warbler (RA=0.31), ovenbird (RA=0.25), white-throated sparrow (RA=0.25) and yellow-bellied sapsucker (*Sphyrapicus varius*; RA=0.25). The species with the greatest relative abundances among control points included the black-throated green warbler (RA=1.00), black-throated blue warbler (RA=0.40), yellow-bellied sapsucker (RA=0.40) and ovenbird (RA=0.30). The species with the greatest frequency (Fr) among impact points include the black-throated blue warbler (Fr=88%), black-throated green warbler (Fr=63%), yellow-bellied sapsucker (Fr=50%), ovenbird (Fr=38%) and white-throated sparrow (Fr=38%). The species with the greatest frequency among control points include the black-throated green warbler (Fr=80%), yellow-bellied sapsucker (Fr=60%), black-throated blue warbler (Fr=40%), ovenbird (Fr=40%) and red-eyed vireo (*Vireo olivaceus*; Fr=40%). The Shannon diversity index is 2.50 for impact points, and 2.17 for control points.

4.3.2.2 Conifer forest

Conifer forest was sampled among 6 impact points and no control points. The species richness was 18 and ranged from 3 to 9 species per point. The species with the greatest relative abundances included the white-throated sparrow (RA=0.75), blackpoll warbler (*Dendroica striata*; RA=0.67) magnolia warbler (*Dendroica magnolia*; RA=0.50) and dark-eyed junco (RA=0.42). The species with the greatest frequencies included the white-throated sparrow (Fr=83%), blackpoll warbler (Fr=67%), dark-eyed junco (Fr=67%), Canada warbler (*Wilsonia canadensis*; Fr=50%), magnolia warbler (Fr=50%), Swainson's thrush (*Catharus ustulatus*; Fr=50%) and winter wren (*Troglodytes troglodytes*; Fr=50%). The Shannon diversity index in conifer forest habitat is 2.62.

4.3.2.3 Deciduous/conifer mixed forest

Mixed forest habitat was sampled among 3 impact points and 3 control points. The species richness among impact points was 12 and ranged from 3 to 9 species per point, and the species richness among control points was 12 and ranged from 8 to 9 species per point. The species with the greatest relative abundances among impact points included the white-throated sparrow (RA=0.83), blackpoll warbler (RA=0.67) and black-throated-blue warbler (RA=0.67). The species with the greatest relative abundances among control points included the blackpoll warbler (RA=1.00), white-throated sparrow (RA=1.00), dark-eyed junco (RA=0.67) and



magnolia warbler (RA=0.67). The species with the greatest frequencies among impact points were the white-throated sparrow (Fr=100%), blackpoll warbler (Fr=67%), black-throated blue warbler (Fr=67%) and yellow-rumped warbler (*Dendroica coronata*; Fr=67%). The species with the greatest frequencies among control points were the blackpoll warbler, black-throated green warbler, dark-eyed junco, magnolia warbler and white-throated sparrow, all of which were detected at 100 percent of the points. The Shannon diversity index is 2.24 for impact points and 2.29 for control points.

4.3.3 Incidental Observations

Twenty-seven birds representing 13 species were observed incidentally between point count surveys. One species, a ruffed grouse (*Bonasa umbellus*), was detected in the Project area between point counts, but not at any of the survey points. One species, a chimney swift (*Chaetura pelagica*), was observed flying overhead during a point count survey, and was excluded from the data analysis. Also excluded from the data analysis were 5 species that were only detected beyond 100 m from the observer, thus possibly not breeding in the area. These species included the American crow (*Corvus brachyrhynchos*), mourning dove (*Zenaida macroura*), scarlet tanager (*Piranga olivacea*), veery (*Catharus fuscescens*) and an unidentified woodpecker. Table 4-3 lists the incidental species observed between point count timeframes.

| Table 4-3 . Birds observed incidentally between point count surveys – Summer 2009 | | | | | | |
|--|-------------------------|--|--|--|--|--|
| Common name | Scientific name | | | | | |
| Bay-breasted warbler | Dendroica castanea | | | | | |
| Black-capped chickadee | Poecile atricapilla | | | | | |
| Black-throated blue warbler | Dendroica caerulescens | | | | | |
| Black-throated green warbler | Dendroica virens | | | | | |
| Blackpoll warbler | Dendroica striata | | | | | |
| Canada warbler | Wilsonia canadensis | | | | | |
| Ovenbird | Seiurus aurocapillus | | | | | |
| Rose-breasted grosbeak | Pheucticus Iudovicianus | | | | | |
| Ruffed grouse* | Bonasa umbellus | | | | | |
| Unidentified woodpecker | n/a | | | | | |
| White-throated sparrow | Zonotrichia albicollis | | | | | |
| Yellow-bellied flycatcher Empidonax flaviventris | | | | | | |
| Yellow-rumped warbler Dendroica coronata | | | | | | |
| * Species not observed during point count surveys | | | | | | |



4.3.4 Bicknell's thrush playback surveys

Playback surveys conducted at all 25 point count locations, including impact and control points, elicited no response from Bicknell's thrush. No Bicknell's thrush was either visually or acoustically detected in the survey areas.

4.4 DISCUSSION

Summer breeding bird surveys documented a total of 36 species in the Project area, including the results of point count surveys and incidental observations. Surveys were conducted during the peak of the nesting season, and were timed to occur in the morning when detection of birds is greatest. Survey dates were aimed to occur during optimal weather conditions for detection; however, there were periods of marginal weather within all survey days, thus reducing the likelihood that all of the breeding birds present were detected during those timeframes. Certain species of bird vocalize less frequently and are, therefore, often under-represented during breeding bird surveys (Farnsworth *et al.* 2002). However, the 2009 surveys at the Project used standard methods, which included VCE protocols, that are comparable to other breeding bird surveys conducted in the region; therefore, the results of the surveys provide a suitable reflection of the baseline breeding bird community in the Project area.

Species richness was greater at the impact points than at the control points, most likely due to the fact that more points and habitats were surveyed at impact points, thus providing a larger sample size. Despite the larger sample size of impact points, the control points had a greater overall mean relative abundance of birds. The impact points and control points had similar habitat types, species compositions, and diversity indexes, providing a good comparison for overall habitat composition and species assemblage of breeding birds.

Level of disturbance varied among all survey points. The highest elevations survey points along the ridgeline are largely undisturbed by human activity, while points at lower elevations have evidence of past logging activity. However, there are areas along the ridgeline with old skidder trails and all terrain vehicle activity, as well as areas with natural disturbances including blowdowns.

Among the habitats sampled, deciduous forest habitat was the dominant habitat in the Project area; consequently deciduous forest was the most frequently sampled habitat type. Conifer forest habitat had the greatest species richness, mean relative abundance, and diversity index. There were no control points located in conifer forest. Despite the fact that there was a smaller sample size for mixed forest points, the mixed forest habitat had the greatest mean relative abundance and diversity index.

Although there were small pockets of montane spruce-fir habitat scattered along the ridgeline of the Project area, there were no Bicknell's thrush detected during the 2009 survey. It is likely that the habitat on-site is marginal for the species, as Bicknell's thrush are known to breed at elevations greater than 3,000' (915 m) and the elevation of the Project area ranges from 2,100' to 2,640' (641 to 802 m). The species detected at KCW were generally common and regionally



abundant species; they are also representative of the habitats in which they were detected. There were no species of state special concern, or state or federally threatened or endangered species observed during the 2009 breeding bird surveys. There were seven species detected in the Project area that are listed under the Vermont Wildlife Action Plan Priority Species List (VFWD 2005) as indicated in Table 4-4.

| Table 4-4. Species observed in the Project Area that are included under the 2005 Vermont Wildlife Action Plan Priority Species List | | | | | | | |
|---|------------------|----------------------------|------------------|--|--|--|--|
| Species | State Ranking | Conservation Assessment | Regionally rare? | | | | |
| Black-throated blue warbler | S5B | Medium priority | No | | | | |
| Bay-breasted warbler | S1B | Medium priority | No | | | | |
| Blackpoll warbler | S4S5B | Medium priority | No | | | | |
| Canada warbler | S5B | High priority | Yes | | | | |
| Chimney swift | S5B | Medium priority | No | | | | |
| Ruffed grouse | S5B | Medium priority | No | | | | |
| Veery | S5B | Medium priority | No | | | | |
| B: breeding | | | | | | | |
| S1: very rare, generally 1 to 5 occurrences believed to be extant and/or some factor(s) making it especially vulnerable to extirpation from the state | | | | | | | |
| S4: apparently secure in state, often with more than 100 occurrences | | | | | | | |
| S5: demonstrably secure in state | | | | | | | |

Of these seven species listed as priority species, 6 species are listed as medium priority and are not considered regionally rare. The rank for bay-breasted warblers is given due to inadequate monitoring and unknown status, and therefore this is a medium priority species with an unknown statewide status. Canada warbler is listed as high priority and is considered regionally rare.

The composition of species detected during breeding bird surveys at The Project was typical of the available habitats in the Project area, which included deciduous forest, coniferous forest, and mixed forest. The predominantly forested ridgeline of the Project area largely influenced the occurrence of the species detected on-site. Although certain habitat generalists such as the mourning dove, American crow and chimney swift were documented in the Project area, forest interior-associated species such as the black-throated blue warbler, dark-eyed junco and ovenbird were far more abundant and frequently detected during on-site breeding bird surveys. The majority of birds found within the Project area are common within the region, and typical of the habitats in which they were observed. No Bicknell's thrush or other state species of concern were observed, and no state or federally threatened or endangered species were detected in the Project area. There were seven species observed in the Project that are included as priority species under the Vermont Wildlife Action Plan Priority Species list (2005); however, these species were all considered regionally abundant (with the exception of Canada warbler).



5.0 Acoustic Bat Survey

5.1 INTRODUCTION

The acoustic survey at The Project was designed to document bat activity patterns and general species composition from April through October across the Project area. Nine species of bats occur in Vermont, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), Indiana bat (*M. sodalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (Whitaker and Hamilton 1998). Of these nine species, the Indiana bat is federally-listed as endangered and the eastern small-footed bat is state-listed as threatened. All nine species are listed as Species of Greatest Conservation Need under Vermont's Wildlife Action Plan (VFWD 2005). Six are high priority species (Indiana bat, small-footed bat, silver-haired bat, tri-colored bat, eastern red bat, and hoary bat), and three are medium priority species (little brown bat, northern long-eared bat, big brown bat). The proposed KCW Project is located in Orleans County, VT, which is outside the known range of the Indiana bat, but within the range of all other species found in Vermont (DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998).

Acoustic sampling of bat activity has become a standard aspect of pre-construction surveys for proposed wind-energy developments (Kunz *et al.* 2007). Pre-construction acoustic bat surveys are designed to collect baseline information on bat activity levels and general species composition. While mist net surveys have the ability to collect precise species information, data collection can only occur over small areas and during discrete amounts of time. Acoustic surveys allow for simultaneous data collection at multiple locations, at varying heights above ground level, and across longer time periods; and as a result, acoustic surveys can provide insight into seasonal patterns of activity levels. While these data may be useful in predicting trends in post-construction mortality rates, the current lack of data on this topic precludes quantitative prediction of risk. However, survey methods represent the best available scientific methodology at this time for determining baseline activity levels and general species composition.

5.2 SURVEY DESIGN

5.2.1 Data Collection Methods

Acoustic detectors were deployed on April 16 and 17, 2009, and ran through October 18, 2009. Anabat SD1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the 2009 acoustic bat survey. Anabat detectors are frequency division detectors, dividing the frequency of echolocation sounds made by bats by a factor of 16, and recording these sounds for subsequent analysis. The audio sensitivity setting of each Anabat system was set between six



and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33'). Detectors were programmed to passively record data between 7:00 pm and 7:00 am via the internal clock on the SD1 detector, and data was stored on removable 1 to 2 GB compact flash cards. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area.

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a curved section of PVC was fitted to the microphone. This set up allows the microphone to record the airspace horizontally in front of the detector.

Currently, pre-construction acoustic methods emphasize monitoring a vertical array of airspace to document species flying at all altitudes around a turbine blade (Arnett et al 2006). Detectors placed above tree canopy height more readily survey long-distance migrants; these species generally fly and forage at high altitudes, and therefore are species that experience the highest turbine collision rates. Resident bat species generally forage close to, or below, the tree canopy. Therefore, ground-level detectors are also necessary to get a complete picture of species composition within the Project area. In order to survey the airspace both above and below tree canopy height, detectors at KCW were deployed both in trees and at the top of portable towers.

5.2.2 Site Selection

Acoustic survey sites at KCW were chosen based on the professional opinion of Stantec and VANR on how bats might move across the Project area. There is conflicting evidence about fatality rates at individual turbines: while some studies show that there is no difference in fatality among individual turbines, other studies have shown that turbines at the leading edges of turbine strings can have higher fatalities, possibly because bats are moving parallel to turbine strings and are therefore encountering the leading turbines at a higher rate (Arnett et al. 2008). In order to assess activity levels at the edges of the proposed turbine string, two acoustic detectors were deployed at the northern end of the Project area ridgeline, and two acoustic detectors were deployed at the southern end (Figure 1-1, Appendix D Tables 1, 2, 4, 5). At each survey location, one detector was deployed at ground level (approximately 1 to 2 m above ground level) in order to survey the airspace below the tree, and a second detector was deployed at the top of a 15 m portable tower in order to survey the airspace above the tree canopy.



There was also concern that a spur running west off the main Project ridgeline could act as a funnel during migration, directing bats to the center of the turbine string rather than the northern or southern extremities of the ridgeline. To survey activity in proximity to this possible funneling landscape feature at the center of the turbine string, an additional detector was deployed at the junction of the western spur and the main ridgeline (Figure 1-1, Appendix D Table 3). At this location, the detector was deployed in the top tree in such a way that the cone of detection was surveying airspace above the surrounding tree canopy.

North Tree Detector (elevation: 2,454'): The North Tree detector was located at the northern end of the Project area (Figure 5-1). This detector was deployed approximately 1.5 m above ground level in a dead snag. The cone of detection looked out over a small clearing in the mixed deciduous/coniferous forest.



Figure 5-1. North Tree detector, Kingdom Community Wind, 2009.



North Tower Detector (elevation: 2,479'): The North Tower detector was located approximately 180' northeast of the North Tree Detector (Figure 5-2). The detector was hung 15 m above ground level in a portable tower, and surveyed the airspace above the surrounding tree canopy.



Figure 5-2. North Tower detector, Kingdom Community Wind, 2009.

Central Tree Detector (elevation: 2,603): The Central Tree detector was located in the center of the Project area, where a western ridgeline meets the main ridgeline (Figure 5-3). This detector was deployed approximately 10 m above ground level in a standing dead tree, and surveyed the airspace above the surrounding tree canopy.





Figure 5-3. Central Tree detector, Kingdom Community Wind, 2009.

South Tree Detector (elevation: 2,480'): The South Tree detector was located at the southern end of the Project area (Figure 5-4). This detector was deployed approximately 2 m above ground level in a standing snag, and surveyed an opening in the forest block.



Figure 5-4. South Tree detector, Kingdom Community Wind, 2009.

South Tower Detector (elevation: 2,480'): The South Tower detector was located approximately 30' south of the South Tree detector, at the southern end of the Project area (Figure 5-5). This detector was deployed approximately 15 m above ground level in a portable tower, and surveyed the airspace above the surrounding tree canopy.





Figure 5-5. South Tower detector, Kingdom Community Wind, 2009.

5.2.3 Data Analysis Methods

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis. Call sequences typically include a series of calls characteristic of normal flight or prey location ("search phase") and capture periods (feeding "buzzes").

Call files were extracted from data files using CFCread® software. The default settings for CFCread® were used during this file extraction process, as these settings are recommended for the calls that are characteristic of northeastern bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can all produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying



frequency. Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al.* 1999, O'Farrell and Gannon 1999).

Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, and other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds² reflecting the bat community in the region of the Project area, as follows:

- Unknown (UNKN) All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz.
- Myotis (MYSP) All bats of the genus Myotis (little brown, northern long-eared, Indiana, and eastern small-footed bats). While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings.
- Eastern red bat/tri-colored (RBTB) Eastern red bats and tri-colored bats. These two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur.
- **Big brown/silver-haired bat (BBSH)** Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.
- Hoary bat (HB) Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

² Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PESU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.



Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined. The time a file was recorded was subtracted from the sunset time on that particular night in order to develop summaries of the number of call files recorded during each hour after sunset.

5.3 RESULTS

5.3.1 Seasonal Activity Levels

Five acoustic detectors were deployed on April 16, 2009 and continued to record data through October 18, 2009, for a total survey period of 186 calendar nights. The range of dates that each detector was deployed is summarized in Table 5-1. All detectors operated successfully for over than 90% of the survey period, except the South Tree detector (76%). Equipment malfunction caused the data gap at the South Tree detector. A combination of heavy wind and rain during late spring caused small data gaps at the South Tower and South Tree detectors.

| Table 5-1. Summary of bat detector field survey effort and results at Kingdom Community Wind, 2009. | | | | | | | | |
|--|-------------------|--------------------|----------------------|-----------------------|----------------------|--------------------------------------|--|--|
| Location | Dates Deployed | Calendar Nights | Detector- Nights* | Recorded Sequences | Detection Rate ** | Maximum Sequences recorded *** | | |
| North Tower | April 17 - Oct 18 | 185 | 185 | 1924 | 10.4 | 304 | | |
| South Tower | April 16 - Oct 18 | 186 | 170 | 1270 | 7.5 | 197 | | |
| Central Tree | April 16 - Oct 18 | 186 | 186 | 1522 | 8.2 | 263 | | |
| North Tree | April 17 - Oct 18 | 185 | 173 | 404 | 2.3 | 63 | | |
| South Tree | April 16 - Oct 18 | 186 | 142 | 5010 | 35.3 | 636 | | |
| Overall Results | | 928 | 856 | 10,130 | 11.8 | | | |

^{*} One detector-night is equal to a one detector successfully operating throughout the night.

Although the VANR-approved acoustic survey work plan stated that detectors would run from April 15 through October 15 in order to capture the full extent of activity, VANR guidelines recommend that the acoustic survey should run through September 30. In order to provide a comparison to projects running through September 30, October data was removed from the dataset and the detection rate was recalculated. A total of 11 call files were recorded during October at the five acoustic detectors. When October was removed from the data set, overall detection rates from April through September 30 was 12.9 detections/detector night (Table 5-2).

^{**} Number of bat echolocation sequences recorded per detector-night.

^{***} Maximum number of bat passes recorded from any single detector for a detector-night.



| Table 5-2. Summary of bat detector field survey effort and results through September 30 at Kingdom Community Wind, 2009. | | | | | | | | |
|---|--------------------|--------------------|----------------------|-----------------------|----------------------|---|--|--|
| Location | Dates Deployed | Calendar Nights | Detector- Nights* | Recorded Sequences | Detection Rate ** | Maximum Sequences recorded *** | | |
| North Tower | April 17 - Sept 30 | 167 | 167 | 1921 | 11.5 | 304 | | |
| South Tower | April 16 - Sept 30 | 168 | 152 | 1267 | 8.3 | 197 | | |
| Central Tree | April 16 - Sept 30 | 168 | 168 | 1518 | 9.0 | 263 | | |
| North Tree | April 17 - Sept 30 | 167 | 155 | 403 | 2.6 | 63 | | |
| South Tree | April 16 - Sept 30 | 168 | 142 | 5010 | 35.3 | 636 | | |
| Overall Results | | 838 | 784 | 10,119 | 12.9 | | | |
| * One detector-night is equal to a one detector successfully operating throughout the night. | | | | | | | | |
| ** Number of bat echolocation sequences recorded per detector-night. | | | | | | | | |
| *** Maximum number of bat passes recorded from any single detector for a detector-night. | | | | | | | | |

A total of 10,130 call files were recorded by five detectors at Kingdom community wind. The South Tree detector recorded half of the total calls (49.5%) and had the highest detection rate during each month of the survey (Table 5-1, Figure 5-6). Approximately half (56%) of the total calls were recorded during the month of July, when detection rates peaked for all but the Central Tree detector. Only 4 percent of call files were recorded at the North Tree detector, and detection rate was the lowest at this detector throughout the season (Table 5-1, Figure 5-6).

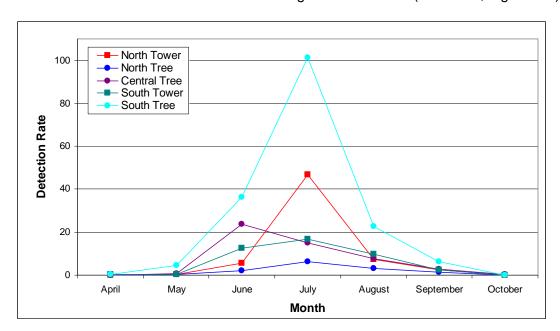


Figure 5-6. Detection rate, as measured by the number of call files recorded per detector-night from April through October for five detectors at KCW, 2009.



5.3.2 Timing of Activity

Activity across the survey period, measured as the number of call sequences recorded per night, was variable and somewhat pulsed. In general, activity increased gradually until mid-July, then decreased through Oct 15 (Figure 5-7).

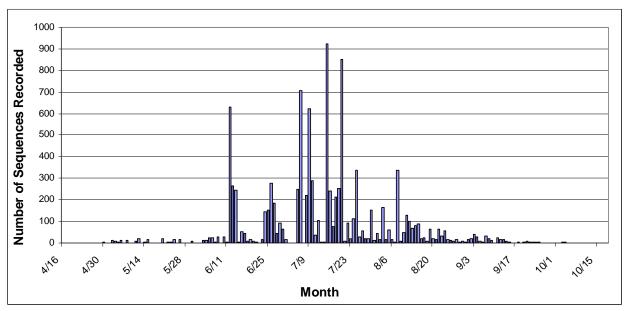


Figure 5-7. Overall activity, as measured by the number of sequences recorded each month by five detectors at KWC, 2009.

Seasonal activity, measured as the number of call sequences recorded each month, varied across detectors (Figure 5-8). At the northern location, the North Tower detector recorded more call sequences than the North Tree detector. The opposite was true at the southern location, where the South Tree detector recorded more calls than the South Tower detector (even accounting for lapses in detector function). Activity at all four detectors (North Tower and North Tree, South Tower and South Tree) peaked in July. The Central Tree detector showed a different pattern; at this location, activity peaked in June, and the total number of calls recorded at the Central Tree detector fell between the total recorded at tower and tree detectors at each location along the ridge.



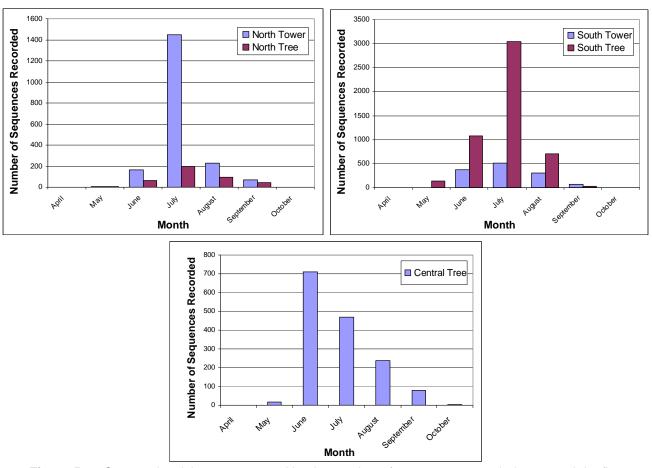


Figure 5-8. Seasonal activity, as measured by the number of sequences recorded per month by five detectors at KWC, 2009.

Nightly activity, measured as the number of call files recorded within each hour after sunset, varied across the ridgeline (Figure 5-9). Activity at the North Tower and North Tree detectors peaked 5 hours after sunset. At the Central Tree detector, activity peaked earlier in the evening, at 1 hour after sunset. At the South Tower and South Tree detectors, activity also peaked earlier in the evening, at 2 hours after sunset, but activity stayed high for the next three hours, with a slight secondary peak at 5 hours after sunset.

400 200

0

1

2

3 4 5 6



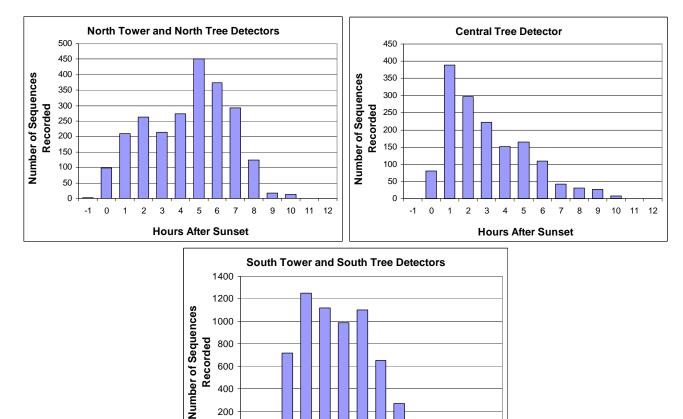


Figure 5-9. Nightly activity, as measured by the number of sequences recorded during each hour after sunset by five detectors at KWC, 2009.

Hours After Sunset

7

8

9 10 11 12

5.3.3 **Species Composition**

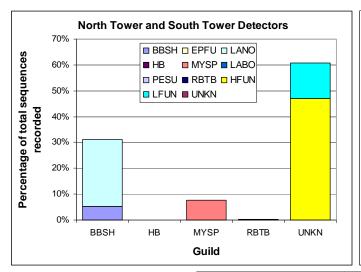
Call sequences belonging to all five guilds were identified during the acoustic survey (Table 5-3). The majority of recorded sequences belonged to the Unknown guild; these files either contained less than five pulses or the recording was not of sufficient quality to assign them to a species guild. Of those sequences assigned to a species guild, the majority belonged to the BBSH (big brown bat/silver-haired bat) guild.

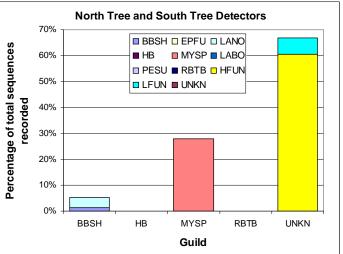


| Table 5-3. Distribution of detections by guild for detectors at Kingdom Community Wind, 2009. | | | | | | | | |
|---|-------|-------|-------|------|-------|--------|--|--|
| Detector | | Total | | | | | | |
| Detector | BBSH | НВ | MYSP | RBTB | UNKN | Total | | |
| North Tower | 264 | 0 | 188 | 6 | 1466 | 1,924 | | |
| South Tower | 728 | 2 | 58 | 5 | 477 | 1,270 | | |
| Central Tree | 803 | 0 | 52 | 0 | 667 | 1,522 | | |
| North Tree | 55 | 0 | 76 | 2 | 271 | 404 | | |
| South Tree | 228 | 2 | 1,431 | 2 | 3,347 | 5,010 | | |
| Total | 2,078 | 4 | 1,805 | 15 | 6,228 | 10,130 | | |
| Guild Composition % | 20.5% | 0.0% | 17.8% | 0.1% | 61.5% | | | |

Species composition varied by acoustic detector height (Figure 5-10). At the North and South Tower detectors (15 m above ground level), the big brown bat/silver-haired bat guild was the most common species guild identified. At the North and South Tree detectors, the Myotis guild was the most common species guild identified (1.5 m above ground level). Results from the Central Tree detector (10 m above ground level) were most similar to the tower detectors, with the BBSH guild the most common species guild identified.







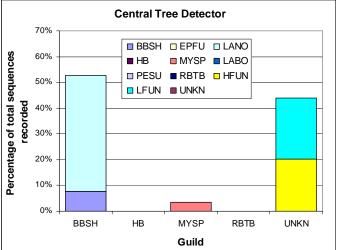


Figure 5-10. Species composition across five detectors at KWC, 2009. Identifications shown for five guilds (BBSH, HB, MYSP, RBTB, UNKN), with suspected species included for each (HB = hoary bat, PESU = tricolored bat, EPFU = big brown bat, LANO = silver-haired bat, LABO = red bat).

5.4 DISCUSSION

The acoustic survey at Kingdom Community Wind provides insight into activity patterns, species composition, and timing of bat movements across the Project area. Over 856 detector-nights, five detectors recorded 11.8 call files per night (12.9 files/night through September 30). Activity was variable among all detectors and across the survey period. Monthly detection rates generally increased until July then decreased for the remainder of the survey.

The five detectors at KCW were deployed at three locations across the ridgeline, with the north and south locations each having two detectors (a tower and a tree detector). Seasonal activity patterns at the northern tower and tree detectors were opposite those at the southern tower and tree detectors. At the southern location, the South Tree detector had consistently higher



detection rates than the South Tower detector throughout the survey period. This pattern is consistent with many acoustic surveys (Arnett et al 2006, Reynolds 2006), where activity is often greatest at ground-level, and decreases as detector height above ground level increases. However, this pattern was not observed at the northern location. Here, the North Tree detector recorded lower detection rates than the North Tower detector. When the data from the tower and tree detectors are combined at each (north and south) location, more calls overall were recorded at the southern location, even though elevation and habitat were similar in both areas. This pattern is driven by the South Tree detector, which had the highest detection rate and recorded the most calls of the four detectors located at the leading edges of the ridgeline (North Tower, North Tree, South Tower, and South Tree).

Nightly activity patterns were different at the northern and southern locations, although these differences were not as dichotomous as with seasonal activity. At the North Tower and North Tree detectors, activity peaked once during the evening at 5 hours after sunset. At the South Tower and South Tree detectors, activity peaked earlier, at 2 hours after sunset, and stayed high until about 5 hours after sunset.

Another pattern observed at regional acoustic surveys is that long-distance migrants (eastern red bats, silver-haired bats, hoary bats) are most often detected at the highest detectors above ground level, and resident species (particularly species in the genus *Myotis*) are most often detected at ground level detectors (Arnett et al 2006, Reynolds 2006). Of the calls at KCW identified to a species guild (i.e., not including the Unknown guild), the North Tower and South Tower detectors recorded primarily BBSH call files, with the vast majority identified as silver-haired bats, whereas the North Tree and South Tree detectors recorded primarily MYSP call files. Not only do these results match the species composition pattern commonly observed during acoustic surveys, but they also indicate that the detectors deployed in portable towers were a good surrogate for detectors deployed in Met towers, in that they demonstrated similar patterns between above- and below-canopy detectors, even though typical Met tower detectors are deployed above 20 m and KCW portable tower detectors were at 15 m.

Although a detector was deployed in a tree at the central location, and was therefore referred to as a "tree" detector, the results from this detector did not match patterns observed at the North Tree and South Tree detectors, and at times were unique to this location. The overall number of recorded files at the Central Tree detector was most similar to results recorded at the North Tower and South Tower detectors. Species composition at the Central Tree location was very similar to that at the North Tower and South Tower location, with the vast majority of calls belonging to silver-haired bats in the BBSH guild. These patterns indicate that although the detector was hung from a tree, it was hung high enough in that tree that it was surveying above the surrounding canopy, and therefore was acting much like a tower detector. However, not all patterns observed at the central location were observed at the tower detectors. Seasonal activity peaked in June at the central location, rather than July like the remaining detectors. And the nightly timing of activity was unique to this location. Activity peaked sharply at 1 hour after sunset, and decreased for the remainder of the night. The data collected cannot explain why that is the case; nor can it tell us whether this will result in different mortality patterns once the



facility is operational; it only indicates that nightly and seasonal activity patterns are different at the central location.

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat have easily identifiable call components that, when present, clearly indicate the species identification. When certain characteristic call components are absent, however, species such as the big brown bat and silver-haired bat are difficult to distinguish acoustically. Similarly, members of the Myotis genus have overlapping call characteristics that often cannot be distinguished qualitatively.

The Unknown (UNKN) guild includes files that were identified as either high-frequency or low-frequency unknown calls. These call files either contained too few pulses to be identifiable or the pulses were not of sufficient quality to identify to a guild. High Frequency Unknown (HFUN) calls could be any of the species included in the MYSP guild or the RBTB guild. Low Frequency Unknown (LFUN) calls could be any of the species included in the BBSH guild or the HB guild. At the northern and southern locations, more files were identified as HFUN than LFUN. At the central location, an equal number of HFUN and LFUN files were recorded.

The MYSP guild can include all 4 species of *Myotis* that occur in Vermont: the little brown bat, the northern long-eared bat, the state threatened eastern small-footed bat, and the federally endangered Indiana bat. Bats in the genus *Myotis* have uniform calls with very steep, sometimes vertical slopes, and relatively constant minimum frequencies of 35 to 40 kHz. At KCW, sequences belonging to the *Myotis* guild were most common at the North Tree (19% of total calls recorded) and South Tree detectors (29% of total calls recorded), and were rarely recorded at the North Tower (10% of total calls recorded), South Tower (5% of total calls recorded), and Central Tree (3% of total calls recorded). These results are not surprising, given that bats belonging to this guild are resident species that forage primarily at or below tree canopy height and so are most often recorded by tree detectors.

The RBTB guild includes the eastern red bat and tri-colored bat. Eastern red bats have relatively unique calls which span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Tri-colored bats tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile resembling a hockey stick. Only 0.1 percent of calls were identified as belonging to this guild, although poor-quality calls from these two species are likely included in low numbers in the Unknown guild.

Similarly, only four call files (0.0%) were identified as belonging to the hoary bat (HB) guild. Hoary bats have calls that are highly variable in minimum frequency and shape. The defining characteristic of hoary bat calls is that the low-frequency pulses have minimum frequencies below 20 kHz.

The BBSH guild includes the big brown bat and silver-haired bat. Calls of silver-haired bats and big brown bats are occasionally identifiable, but often overlap in range and can be difficult to distinguish, especially when comparing short duration calls typical of those recorded during



passive monitoring. At KCW, calls were most often identified as belonging to the BBSH guild, and the majority of these were further identified as silver-haired bats. Overall, 17 percent (n = 1,721) of all call files recorded were identified as silver-haired bats.

Both migratory and resident bat species were detected at The Project. Activity at all detectors followed an expected pattern, with low activity in spring and fall and high activity in summer. However, the data are not able to indicate whether there was pronounced northward movement in the spring or southward movement in the fall, which might have been indicated by higher activity at the southern locations in the spring followed by higher activity at the northern detectors during the fall, or by higher activity during the migratory periods than the summer period at any of the detectors. The overall higher activity at the southern location throughout the survey period may simply indicate that the southern detectors were placed closer to foraging areas than the northern detectors. Results do indicate that nightly and seasonal activity patterns were slightly different at the central location.

When considering the level of activity documented at The Project, it is important to acknowledge that numbers of recorded bat call sequences cannot be correlated with the number of bats in an area because acoustic detectors do not allow for differentiation between individuals (Hayes 2000). Typically, inferences drawn from acoustic data are also limited by a lack of replication (additional sampling) throughout the Project area at various heights. Thus, results of acoustic surveys must be interpreted with caution. Methods surrounding acoustic bat surveys are continually evolving and there is currently little data aiding in the interpretation of the number of calls per detector night. Although interpretations are limited, the surveys represent a sample of activity and the general species groups that occur in the Project area.



6.0 Small-footed Bat Habitat Assessment

6.1 INTRODUCTION

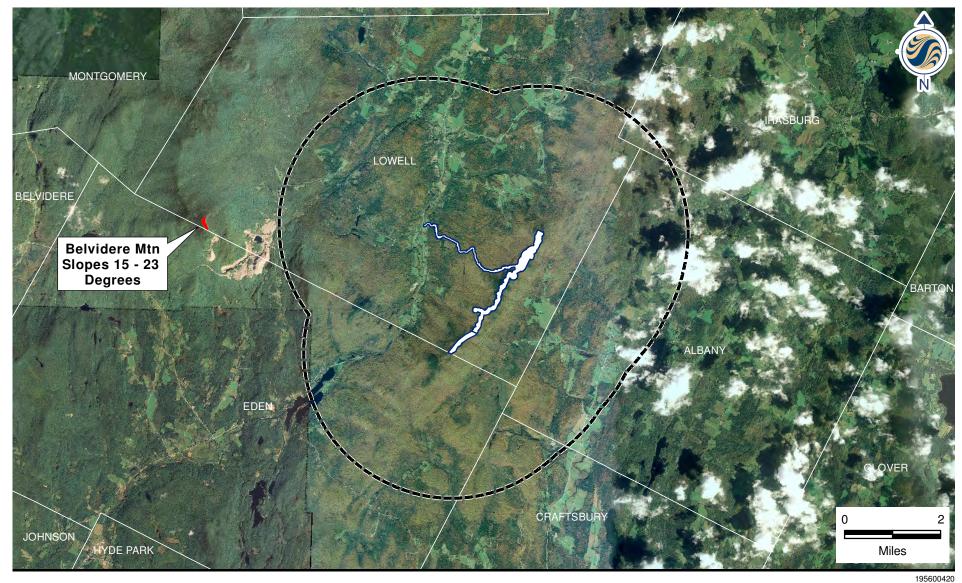
Of the nine species of bats occur in Vermont, the eastern small-footed bat is state-listed as threatened, with a rank of SI ("Critically Imperiled"), and the Indiana bat is listed as endangered, under the Vermont Endangered Species Law (10 V.S.A. Chap. 123 section 5401). The proposed Project is located in Orleans County, VT, which is outside the known range of the Indiana bat, but within the range of the eastern small-footed bat (DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998). The eastern small-footed bat is considered one of the rarer bats in the eastern United States (Best and Jennings 1997). Little is known about its ecology, due in part to the small size and rarity of the species: telemetry studies of eastern small-footed bats are limited due to concerns over radiotransmitter weights in relation to small body mass.

The limited data on eastern small-footed bat day-roosting behavior suggest strong preference for roosting underneath rocks as well as in rock crevices among rock outcrops, cliff-faces, and talus slopes, although there are scattered records of roosting in buildings, trees, and bridges (Best and Jennings 1997, Johnson and Gates 2008, Roble 2004). High temperatures inside roosts are known to be advantageous to pregnant and lactating females (Solick and Barclay, 2006); therefore, roosts often have a southerly aspect to increase solar gain.

Since little is known about eastern small-footed bat roosting habitat, a common first step when investigating species presence is to use remote data to look for common roosting characteristics. Three characteristics of what is thought to be the most suitable habitat for day-roosts – (1) steep slopes, (2) visible rock formations, and (3) southerly aspect – were used to identify potential roosting locations for eastern small-footed bats. Under direction from VANR, 30° was chosen as the slope cut-off point, and areas with slopes greater than 30° were included in the initial stages of analysis. Although a somewhat arbitrary value for slope, this was determined to be an efficient way of identifying steep slopes through remote means in the absence of more precise information on eastern small-footed bat roost habitat.

6.2 METHODS

ArcMap Spatial Analyst (ESRI, Redlands, CA) was used to model potential eastern small-footed bat habitat. The August 2009 Project area was buffered by three miles on all sides, and areas within the 3-mile buffer were included in the analysis (Figure 6-1). Degree of slope was calculated for every pixel in the 10 m USGS National Elevation Dataset, and locations with slopes greater than 30° were identified. Identified areas were overlaid with 2003 color orthophotography from the Vermont Center for Geographic Information (www.vcgi.com). Areas having both steep slopes and observable exposed rock were further categorized as potential roosting areas if they had aspects facing south (135° to 225°) or southwest (225° to 315°).





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Legend

Slopes Greater Than 15 Degrees

Project Impact Area

Project Impact Area 3 Mile Buffer

Client/Project

VERA Lingdom Community Wind Lowell Mountain Lowell, Vermont

Figure No.

6-1

Title

Potential Small Footed Bat Habitat

12/14/2009

00420_F6-1_SmallFootedBat.mxd

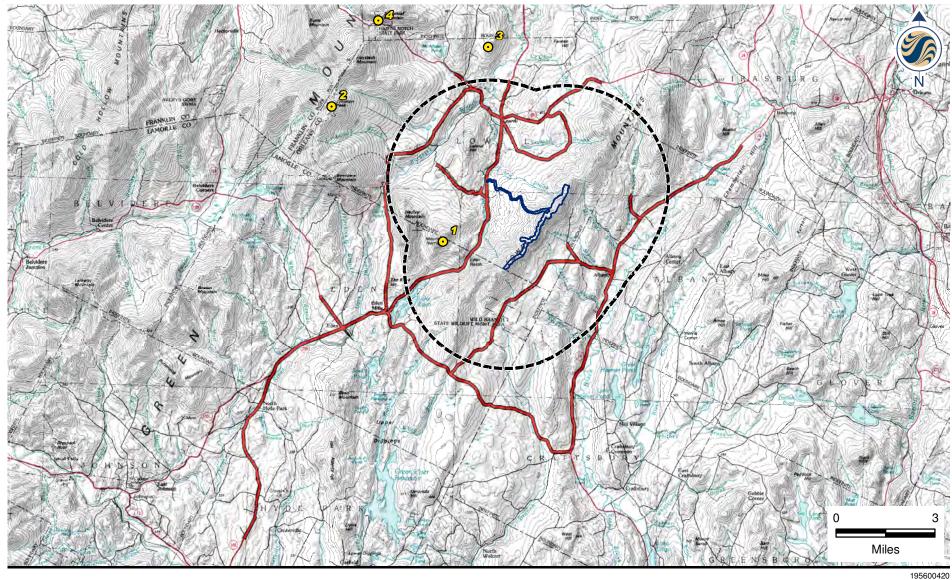


A site visit was conducted to document any potential habitat within the 3-mile buffer that was missed by the desktop analysis. Photographs were taken of potential habitat and the location was noted by GPS. A GPS track log was recorded to illustrate the areas around the Project area that were visited.

6.3 RESULTS

The desktop analysis identified no areas within three miles of the Project area that had slopes greater than 30° (Figure 6-1). In addition, there were no areas identified within three miles of the Project area that had slopes greater than 15° (Figure 6-1).

A site visit was conducted on November 10, 2009 to determine whether there were obvious rock faces or cliffs in the area that were not identified by the desktop analysis. During the site visit, 68.5 miles of road within three miles of the Project area were driven (Figure 6-2). A total of four sites were identified as having exposed rock. None of these sites were categorized as potential habitat within the 3-mile Project area buffer: one of four sites was within 3 miles of the Project area but rock formations did not have a southerly aspect; two of four sites had rock formations with a southerly aspect but were 5 to 7 miles away from the Project area (2 to 4 miles from the Project area buffer); and one of four sites had eastern-facing rock formation but was 6 miles away from the Project area (3 miles away from the Project area buffer).





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00420-F6-2-SmallFootedBatEffort.mxd

Legend

Sites

Observation Route

Project Impact Area

Project Impact Area 3 Mile Buffer

Client/Project

VERA Lingdom Community Wind Lowell Mountain

Lowell, Vermont

Figure No.

6-2

Title

Small Footed Bat Habitat Observation Routes

2/1/2010



Rocky areas were observed on Mount Norris (Figure 6-3, also see Figure 6-2 Site 1). This mountain is located in the western corner of the three mile buffer area. The observed rock formations face east, with an approximate aspect of 107°, and therefore this area was not considered potential habitat.



Figure 6-3. The eastern slope of Mount Norris, Lowell, VT.



Bare rock was evident on Tillotson Peak (Figure 6-4, also see Figure 6-2 Site 2), part of a ridgeline running north-to-south that includes Haystack Mountain and Belvidere Mountain. This was not considered potential eastern small-footed bat habitat as this slope faces east. In addition, this site is approximately 6 miles from the Project area (approximately 3 miles outside the 3-mile buffer boundary).



Figure 6-4. The eastern slope of Tillotson Peak, Lowell, VT, approximately 6 miles from the Project area (red circles indicate areas of exposed rock).



Bare rock was also evident on Browns Ledges, a knob located north of Route 58 and west of Route 100 (Figure 6-5, also see Figure 6-2 Site 3). This cliff faces southeast and has an aspect of approximately 150°. It could be considered potential eastern small-footed bat habitat; however, it is approximately 5 miles from the Project area (approximately 2 miles outside the 3-mile buffer boundary).



Figure 6-5. The southern slope of Browns Ledges, Lowell, VT, approximately 5 miles from the Project area.



A rock cliff was observed in Hazens Notch (Figure 6-6, also see Figure 6-2 Site 4), part of the same ridgeline that runs between Haystack Mountain and Belvidere Mountain. This area could be considered potential habitat due to its size and southern aspect; however, at over seven miles from the Project area, it is far outside the three mile Project area buffer.



Figure 6-6. Hazen's Notch, looking west, Westfield, VT, approximately 7 miles from the Project area.



6.4 DISCUSSION

There was no potential eastern small-footed bat habitat detected within the 3-mile Project area buffer during the remote assessment. Furthermore, there were no south-facing rock formations observed within three miles of the Project area during a site visit. There seems to be little, if any, potential eastern small-footed bat habitat in the area based on the results from these two methods.

There were no areas identified as having slopes greater than 30°, likely because a 10 m DEM was used to examine slope. Elevation data at a finer scale may have picked up smaller areas with steep slopes; however, this data was not available for the three mile buffer area. A site visit was conducted to compare the desktop assessment to actual site conditions. Observations were made by driving throughout the three mile buffer area and looking for areas of exposed rock that were facing south or southwest. In general, there were very few observations of exposed rock faces made, and in fact there was little in the way of abrupt topography in the region as a whole. The eastern portion of the three mile buffer area was characterized by rolling hills with gradual changes in elevation; this area did not look like it would contain rocky areas, and none were observed. There were some exposed rock faces to the west of the Project area; however, all of these areas were outside the three mile buffer area, and most were facing east. Only one location, Browns Ledges, had exposed rock with an aspect within the range of 135° to 315°. This rocky outcrop was not viewed at close range, but looks from afar like it could be considered potential habitat. However, it is located approximately 5 miles from the Project area, and therefore it may be unlikely that any small-footed bats roosting there would be using the KCW Project area.

This survey can identify high-quality eastern small-footed bat day-roost habitat, and none was identified within 3 miles of the Project area. However, eastern small-footed bats are one of the least-understood eastern bat species. Remote methods for identifying eastern small-footed bat habitat rely on searching for steep slopes with visible rock formations. This method makes sense from a logistical point of view: it is a way of efficiently locating steep slopes to search for talus habitat. However, this approach may be limited in a biological point of view. Although exposed, steep talus slopes are likely the most suitable habitat for eastern small-footed bats, they are not the only type of habitat used as day-roosts: small rock formations (both forested and unforested), bridges, and buildings may also be used, although probably to a much lesser degree. Therefore, we can conclude only that no high quality potential habitat was identified given the approach and data sources used.



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Bird and Bat Pre-construction Surveys for Kingdom Community Wind Project in Lowell, Vermont - Appendices

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December 2009



Appendix A

Radar Survey Data Tables



| Apper | ndix A Table 1. | Survey dates | s, results, level | of effort, and | weather - Ki | ngdom Commu | ınity Wind, Fall | 2008 |
|---------------|-----------------|---------------------|----------------------|------------------|--------------------|-----------------|---------------------|--------------------------------|
| Date | Passage rate | Flight Direction | Flight Height (m) | % below 135 m | Hours of Survey | Temperature (C) | Wind Speed (m/s) | Wind Direction (degrees) |
| 9/12 | 12 | 141 | 370 | 4% | 9 | 14 | 4 | 295 |
| 9/13 | 323 | 287 | 240 | 30% | 9 | 16 | 4 | 198 |
| 9/14 | 118 | 52 | 278 | 23% | 12 | 20 | 7 | 220 |
| 9/15 | 236 | 209 | 341 | 6% | 9 | 7 | 2 | |
| 9/16 | 556 | 211 | 255 | 22% | 12 | 7 | 4 | |
| 9/17 | 574 | 179 | 316 | 18% | 11 | 10 | 5 | |
| 9/18 | 474 | 253 | 348 | 13% | 9 | 2 | 4 | |
| 9/19 | 88 | 43 | 262 | 25% | 12 | 6 | 7 | |
| 9/25 | 242 | 29 | 309 | 19% | 12 | 15 | 3 | |
| 9/29 | 515 | 263 | 491 | 9% | 12 | 12 | 7 | |
| 9/30 | 202 | 359 | 339 | 19% | 8 | 9 | 2 | |
| 10/2 | 434 | 195 | 217 | 36% | 12 | 3 | 6 | |
| 10/3 | 292 | 194 | 208 | 29% | 13 | 3 | 6 | |
| 10/4 | 1372 | 225 | 253 | 22% | 13 | 3 | 2 | |
| 10/5 | 409 | 230 | 446 | 7% | 13 | 2 | 2 | |
| 10/6 | 616 | 232 | 496 | 7% | 13 | 1 | 3 | |
| 10/7 | 80 | 210 | 534 | 2% | 13 | 4 | 5 | |
| 10/8 | 80 | 183 | 351 | 2% | 13 | 9 | 6 | |
| 10/10 | 303 | 234 | 474 | 5% | 12 | 6 | | |
| 10/13 | 36 | 346 | 440 | 8% | 13 | 12 | | |
| Entire season | 356 | 226 | 350 | 16% | 12 | 8 | 4 | |



| Append | ix A Table 2. | Survey dates, | results, level | of effort, and v | weather - Kin | gdom Commun | ity Wind, Sprir | ng 2009 |
|------------------|---------------|---------------------|----------------------|------------------|--------------------|-----------------|---------------------|--------------------------------|
| Date | Passage rate | Flight Direction | Flight Height (m) | % below 135 m | Hours of Survey | Temperature (C) | Wind Speed (m/s) | Wind Direction (degrees) |
| 4/23 | 210 | 115 | 219 | 38% | 11 | 1 | 4 | 350 |
| 4/24 | 323 | 48 | 371 | 20% | 9 | 12 | 6 | 209 |
| 4/27 | 751 | 75 | 382 | 16% | 7 | 19 | 6 | 288 |
| 4/28 | 128 | 199 | 153 | 52% | 10 | 0 | 4 | 352 |
| 4/29 | 152 | 103 | 274 | 25% | 10 | 4 | 3 | 332 |
| 5/4 | 222 | 275 | 278 | 38% | 9 | 8 | 8 | 191 |
| 5/5 | 102 | 356 | 277 | 17% | 10 | 7 | 4 | 75 |
| 5/11 | 356 | 72 | 342 | 21% | 10 | 5 | 3 | 143 |
| 5/17 | 165 | 119 | 231 | 31% | 8 | 5 | 3 | 331 |
| 5/18 | 153 | 110 | 203 | 36% | 9 | 1 | 2 | 349 |
| 5/19 | 319 | 88 | 386 | 14% | 9 | 2 | 3 | 324 |
| 5/25 | 58 | 272 | 288 | 52% | 9 | 10 | 4 | 329 |
| 5/26 | 198 | 38 | 335 | 12% | 9 | 1 | 3 | 19 |
| 5/27 | 8 | 43 | 253 | 17% | 4 | 8 | 4 | 169 |
| 5/29 | 176 | 145 | 517 | 14% | 8 | 10 | 3 | 331 |
| Entire Season | 219 | 81 | 298 | 22% | 9 | 6 | 4 | |



| Night of | | | Pas | sage R | ate (tai | rgets/kr | n/hr) by | y hour a | after s | unset | | | | | Entire N | ight | |
|--------------|------|------|------|--------|----------|----------|----------|----------|---------|-------|-----|-----|-----|------|----------|-------|----|
| Night of | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Mean | Median | Stdev | SE |
| 9/12 | N/A | 21 | N/A | N/A | 46 | 0 | 11 | 3 | 4 | 5 | 14 | 0 | N/A | 12 | 5 | 15 | 5 |
| 9/13 | 296 | 741 | 686 | 411 | 379 | 155 | 111 | 86 | N/A | N/A | 43 | N/A | N/A | 323 | 296 | 256 | 85 |
| 9/14 | 157 | 107 | 94 | 118 | 79 | 107 | 136 | 158 | 86 | 204 | 111 | 64 | N/A | 118 | 109 | 39 | 11 |
| 9/15 | 69 | 343 | N/A | N/A | 214 | 252 | 236 | 182 | 289 | 274 | 261 | N/A | N/A | 236 | 252 | 77 | 26 |
| 9/16 | 1484 | 1500 | 1114 | 757 | 521 | 456 | 386 | 155 | 114 | 99 | 86 | 0 | N/A | 556 | 421 | 543 | 15 |
| 9/17 | 311 | 870 | 784 | 664 | 757 | 600 | N/A | 536 | 541 | 482 | 654 | 111 | N/A | 574 | 600 | 218 | 66 |
| 9/18 | 279 | 459 | 656 | 737 | 771 | 651 | 354 | 196 | 158 | N/A | N/A | N/A | N/A | 474 | 459 | 238 | 79 |
| 9/19 | 186 | 155 | 118 | 138 | 107 | 86 | 79 | 64 | 43 | 54 | 26 | 0 | N/A | 88 | 82 | 55 | 16 |
| 9/25 | 137 | 370 | 315 | 321 | 411 | 321 | 236 | 164 | 129 | 204 | 182 | 118 | N/A | 242 | 220 | 102 | 29 |
| 9/29 | 225 | 617 | 777 | 846 | 986 | 1021 | 643 | 450 | 386 | 75 | 90 | 70 | N/A | 515 | 534 | 352 | 10 |
| 9/30 | 124 | 326 | 403 | 321 | 157 | 150 | 115 | 21 | N/A | N/A | N/A | N/A | N/A | 202 | 154 | 131 | 46 |
| 10/2 | 336 | 1007 | 1307 | 1254 | 514 | 501 | 129 | 70 | 11 | 36 | 21 | 26 | N/A | 434 | 232 | 494 | 14 |
| 10/3 | 236 | 193 | 279 | 293 | 207 | 407 | 343 | 489 | 521 | 439 | 134 | 230 | 29 | 292 | 279 | 144 | 40 |
| 10/4 | 279 | 3051 | 2657 | 2700 | 2546 | 1554 | 1596 | 1195 | 700 | 681 | 407 | 434 | 32 | 1372 | 1195 | 1059 | 29 |
| 10/5 | 193 | 300 | 541 | 523 | 571 | 632 | 539 | 536 | 418 | 380 | 343 | 321 | 21 | 409 | 418 | 174 | 48 |
| 10/6 | 21 | 1039 | 1232 | 1141 | 939 | 857 | 957 | 670 | 509 | 327 | 182 | 139 | 0 | 616 | 670 | 443 | 12 |
| 10/7 | 219 | 129 | 43 | 107 | 86 | 64 | 81 | 75 | 50 | 69 | 32 | 86 | 0 | 80 | 75 | 53 | 15 |
| 10/8 | 17 | 86 | 50 | 64 | 50 | 107 | 124 | 100 | 150 | 114 | 71 | 107 | 0 | 80 | 86 | 43 | 12 |
| 10/10 | N/A | 404 | 479 | 446 | 380 | 446 | 383 | 300 | 214 | 121 | 171 | 150 | 143 | 303 | 340 | 135 | 39 |
| 10/13 | 36 | 21 | 32 | 21 | 59 | 36 | 64 | 70 | 21 | 24 | 29 | 36 | 21 | 36 | 32 | 17 | 5 |
| ntire Season | 256 | 587 | 643 | 604 | 489 | 420 | 343 | 276 | 241 | 211 | 159 | 118 | 31 | 356 | 265 | 458 | 30 |

0 indicates no targets counted for that hour



| Appendix A Table 4. Summary of passage rates by hour, night, and for entire season - Kingdom Community Wind, Spring 2009. | | | | | | | | | | | | | | |
|---|-----|------|--------|----------|---------|----------|--------|---------|-------|-----|------|------------|-------|----|
| Night of | | Pass | age Ra | te (tarç | gets/kn | n/hr) by | / hour | after s | unset | | | Entire Nig | ght | |
| Night of | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | Median | Stdev | SE |
| 4/23 | 39 | 179 | 164 | 243 | 246 | 321 | 307 | 329 | 329 | 132 | 229 | 245 | 98 | 31 |
| 4/24 | 250 | 314 | 382 | 314 | 364 | 357 | 356 | 289 | 279 | N/A | 323 | 314 | 45 | 15 |
| 4/27 | 346 | 798 | 889 | 861 | 825 | 861 | 679 | N/A | N/A | N/A | 751 | 825 | 192 | 72 |
| 4/28 | 168 | 186 | 193 | 211 | 164 | 96 | 64 | 29 | 36 | 129 | 128 | 146 | 67 | 21 |
| 4/29 | 29 | 79 | 137 | 174 | 214 | 200 | 171 | 211 | 179 | 121 | 152 | 173 | 61 | 19 |
| 5/4 | 168 | 186 | 304 | 350 | 321 | 219 | 193 | 146 | 107 | N/A | 222 | 193 | 84 | 28 |
| 5/5 | 75 | 73 | 159 | 193 | 150 | 100 | 70 | 71 | 64 | 64 | 102 | 74 | 47 | 15 |
| 5/11 | 39 | 471 | 761 | 497 | 221 | 289 | 373 | 394 | 486 | 32 | 356 | 384 | 222 | 70 |
| 5/17 | N/A | 286 | 304 | 243 | 171 | 100 | 118 | 71 | 25 | N/A | 165 | 145 | 103 | 37 |
| 5/18 | 0 | 171 | 318 | 240 | 155 | 139 | 146 | 129 | 75 | N/A | 153 | 146 | 90 | 30 |
| 5/19 | 146 | 236 | 354 | 429 | 418 | 356 | 468 | 254 | 214 | N/A | 319 | 354 | 111 | 37 |
| 5/25 | 0 | 114 | 104 | 96 | 79 | 75 | 14 | 39 | 0 | N/A | 58 | 75 | 45 | 15 |
| 5/26 | 100 | 221 | 236 | 204 | 286 | 239 | 150 | 146 | N/A | N/A | 198 | 213 | 61 | 22 |
| 5/27 | N/A | N/A | N/A | N/A | 7 | 21 | 4 | 0 | N/A | N/A | 8 | 5 | 9 | 5 |
| 5/29 | 121 | 150 | 207 | 193 | N/A | 193 | 221 | 171 | 150 | N/A | 176 | 182 | 34 | 12 |
| Entire Season | 114 | 247 | 322 | 303 | 259 | 238 | 222 | 163 | 162 | 96 | 223 | 182 | 183 | 16 |

0 indicates no targets counted for that hour



| | Appendix A Table 5. Mea | n Nightly Flight | Directions - Ki | ngdom Community Wind. | |
|------------------|-------------------------|-------------------|------------------|-----------------------|-------------------|
| | Fall 2008 | | | Spring 2009 | |
| Night of | Mean Flight Direction | Circular Stdev | Night of | Mean Flight Direction | Circular Stdev |
| 9/12 | 141 | 46 | 4/23 | 115.265° | 48.147° |
| 9/13 | 287 | 65 | 4/24 | 47.691° | 25.343° |
| 9/14 | 52 | 27 | 4/27 | 75.391° | 42.809° |
| 9/15 | 209 | 59 | 4/28 | 198.701° | 82.931° |
| 9/16 | 211 | 49 | 4/29 | 103.388° | 52.252° |
| 9/17 | 179 | 61 | 5/4 | 274.735° | 43.726° |
| 9/18 | 253 | 29 | 5/5 | 355.832° | 54.913° |
| 9/19 | 43 | 44 | 5/11 | 72.248° | 54.401° |
| 9/25 | 29 | 41 | 5/17 | 119.25° | 64.816° |
| 9/29 | 263 | 61 | 5/18 | 109.526° | 36.341° |
| 9/30 | 359 | 47 | 5/19 | 88.335° | 56.439° |
| 10/2 | 195 | 44 | 5/25 | 272.148° | 117.798° |
| 10/3 | 194 | 33 | 5/26 | 38.282° | 59.105° |
| 10/4 | 225 | 28 | 5/27 | 42.69° | 48.276° |
| 10/5 | 230 | 28 | 5/29 | 145.478° | 52.319° |
| 10/6 | 232 | 24 | | | |
| 10/7 | 210 | 38 | | | |
| 10/9 | 183 | 47 | | | |
| 10/10 | 234 | 36 | | | |
| 10/13 | 346 | 84 | | | |
| Entire Season | 226 | 60 | Entire Season | 80.512° | 71.455° |



| Appendix A Table 6. Summary of mean flight heights by hour, night, and for entire season - Kingdom Community Wind, Fall 2008. | | | | | | | | | | | | | | | | | | |
|---|--------|--------|-----|--------|---------|-------|-------|-------|---------|------|-----|--------|-------|-----------|-----------|------|---------|---------------------------|
| Appendix / | 1 able | o. Sui | | | | | | | | | | entire | 5ea50 | on - King | | | iu, rai | |
| Night of | | | IV | lean F | lignt r | eignt | (m) b | y nou | r after | suns | et | | | | Entire Ni | gnt | | % of targets below 135 |
| Night of | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Mean | Median | STDV | SE | meters |
| 9/12 | | 350 | | | 286 | 331 | 613 | 345 | 295 | | | | N/A | 370 | 338 | 122 | 50 | 4% |
| 9/13 | 202 | 318 | 221 | 223 | 261 | 349 | 250 | 240 | | | 97 | | N/A | 240 | 240 | 72 | 24 | 30% |
| 9/14 | 219 | 230 | 262 | 307 | 278 | 272 | 273 | 271 | 289 | 330 | 325 | | N/A | 278 | 273 | 35 | 11 | 23% |
| 9/15 | 192 | 224 | | | 439 | 429 | 411 | 389 | 318 | 339 | 331 | | N/A | 341 | 339 | 87 | 29 | 6% |
| 9/16 | 346 | 282 | 234 | 255 | 280 | 177 | 256 | 244 | 221 | 238 | 270 | | N/A | 255 | 255 | 42 | 13 | 22% |
| 9/17 | 295 | 302 | 273 | 284 | 288 | 289 | | | 410 | 401 | 351 | 266 | N/A | 316 | 292 | 52 | 17 | 18% |
| 9/18 | 394 | 395 | 362 | 327 | 342 | 311 | 377 | 287 | 336 | | | | N/A | 348 | 342 | 37 | 12 | 13% |
| 9/19 | 134 | 280 | 244 | 284 | 354 | 332 | 280 | 250 | 235 | 201 | 313 | 238 | N/A | 262 | 265 | 60 | 17 | 25% |
| 9/25 | 190 | 199 | 275 | 255 | 333 | 402 | 353 | 335 | 342 | 342 | 355 | 322 | N/A | 309 | 334 | 65 | 19 | 19% |
| 9/29 | 319 | 375 | 447 | 433 | 350 | 375 | 462 | 650 | 787 | 719 | 585 | 392 | | 491 | 440 | 156 | 45 | 9% |
| 9/30 | 242 | 308 | 369 | 361 | 423 | 302 | 366 | | | | | | | 339 | 361 | 59 | 22 | 19% |
| 10/2 | 240 | 244 | 270 | 282 | 285 | 291 | 204 | 148 | 228 | 28 | 115 | 247 | 242 | 217 | 242 | 77 | 21 | 36% |
| 10/3 | 187 | 279 | 219 | 241 | 206 | 176 | 225 | 225 | 189 | 177 | 200 | 155 | 219 | 208 | 206 | 32 | 9 | 29% |
| 10/4 | 230 | 280 | 254 | 275 | 270 | 265 | 240 | 283 | 284 | 264 | 281 | 224 | 140 | 253 | 265 | 40 | 11 | 22% |
| 10/5 | 300 | 460 | 482 | 496 | 516 | 501 | 492 | 509 | 473 | 451 | 431 | 356 | 336 | 446 | 473 | 71 | 20 | 7% |
| 10/6 | 405 | 427 | 501 | 520 | 589 | 538 | 528 | 524 | 461 | 451 | 466 | 444 | 600 | 496 | 501 | 60 | 17 | 7% |
| 10/7 | 333 | 458 | 628 | 524 | 543 | 593 | 621 | 569 | 596 | 569 | 499 | 401 | 602 | 534 | 569 | 89 | 25 | 2% |
| 10/8 | 360 | 214 | 372 | 178 | 328 | 407 | 414 | 394 | 377 | 387 | 441 | 391 | 305 | 351 | 377 | 78 | 22 | 2% |
| 10/10 | | 378 | 481 | 501 | 554 | 519 | 520 | 530 | 513 | 472 | 408 | 406 | 401 | 474 | 491 | 60 | 17 | 5% |
| 10/13 | 234 | | | 241 | | 376 | 335 | 427 | 382 | 703 | 352 | 502 | 848 | 440 | 379 | 197 | 62 | 8% |
| ntire Season | 268 | 316 | 347 | 333 | 364 | 362 | 380 | 368 | 374 | 380 | 342 | 334 | 410 | 350 | 331 | 130 | 9 | 16% |

⁻⁻ indicates no targets counted for that hour



| Appendix A Table 7. S | Appendix A Table 7. Summary of mean flight heights by hour, night, and for entire season - Kingdom Community Wind, Spring 2009. | | | | | | | | | | | | | | |
|-----------------------|---|-----|---------|--------|--------|--------|--------|---------|------|-----|------|------------|------|----|--------------|
| | | Mea | an Flig | ht Hei | ght (m |) by h | our af | ter sur | nset | | | Entire Nig | ght | | % of targets |
| Night of | | | _ | | _ | | _ | | | | | | | | below 135 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | Median | STDV | SE | meters |
| 4/23 | 250 | 262 | 225 | 258 | 245 | 222 | 194 | 142 | 183 | 211 | 219 | 224 | 38 | 12 | 38% |
| 4/24 | 225 | 394 | 428 | 447 | 467 | 432 | 447 | 381 | 317 | 170 | 371 | 411 | 102 | 32 | 20% |
| 4/27 | 229 | 337 | 387 | 415 | 485 | 438 | N/A | N/A | N/A | N/A | 382 | 401 | 90 | 37 | 16% |
| 4/28 | 92 | 157 | 236 | 250 | 187 | 115 | 292 | 11 | 56 | 139 | 153 | 148 | 89 | 28 | 52% |
| 4/29 | | 213 | 249 | 209 | 315 | 223 | 294 | 296 | 351 | 311 | 274 | 294 | 51 | 17 | 25% |
| 5/4 | 129 | 292 | 351 | 268 | 335 | 287 | 377 | 327 | 201 | 214 | 278 | 289 | 77 | 24 | 38% |
| 5/5 | | 392 | 316 | 342 | 313 | 252 | 280 | 230 | 172 | 193 | 277 | 280 | 72 | 24 | 17% |
| 5/11 | 110 | 348 | 369 | 357 | 405 | 401 | 424 | 342 | 327 | | 342 | 357 | 93 | 31 | 21% |
| 5/17 | N/A | 330 | 212 | 218 | 135 | 209 | 267 | 366 | 109 | | 231 | 215 | 88 | 31 | 31% |
| 5/18 | 224 | 239 | 217 | 185 | 170 | 171 | 276 | 177 | 169 | N/A | 203 | 185 | 38 | 13 | 36% |
| 5/19 | 266 | 388 | 358 | 343 | 386 | 539 | 456 | 369 | 366 | N/A | 386 | 369 | 76 | 25 | 14% |
| 5/25 | 524 | 202 | 250 | 159 | 242 | 412 | 355 | 160 | | N/A | 288 | 246 | 131 | 46 | 52% |
| 5/26 | 322 | 551 | 415 | 334 | 335 | 381 | 353 | 206 | 117 | N/A | 335 | 335 | 122 | 41 | 12% |
| 5/27 | N/A | N/A | N/A | N/A | 218 | 252 | 308 | 234 | N/A | N/A | 253 | 243 | 39 | 19 | 17% |
| 5/29 | 201 | 468 | 506 | 522 | N/A | 509 | 478 | 640 | 817 | N/A | 517 | 507 | 173 | 61 | 14% |
| Entire Season | 234 | 327 | 323 | 308 | 303 | 323 | 343 | 277 | 265 | 206 | 298 | 289 | 124 | 10 | 22% |

-- indicates no targets counted for that hour



Appendix A, Table 8. Publicly Available Survey Tables for Fall and Spring Radar Surveys in the theorem US.

| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|------|---|----------------------------------|---------------------------------|---------------------------------------|---|--|--------------------------------|------------------------------------|---|--|
| 2005 | Dairy Hills, Clinton Cty, NY | 57 | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (n/a) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Perry, Wyoming Cty, NY | n/a | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Alabama, Genesee Cty, NY | 59 | n/a | Agricultural plateau | 67 | n/a | 219 | 489 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2004 | Sheffield, Caledonia Cty, VT | 18 | 176 | Forested ridge | 91 | 19-320 | 200 | 566 | (125 m) 1% | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2005 | Alabama, Genesee Cty, NY | 40 | n/a | Agricultural plateau | 111 | n/a | 35 | 413 | (125 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | New Grange, Chautauqua Cty, NY | 57 | n/a | Great Lakes plain | 112 | n/a | 208 | 458 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Churubusco, Clinton Cty, NY | 38 | 414 | Great Lakes plain/ADK foothills | 152 | 9-429 | 193 | 438 | (120 m) 5% | Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Maple Ridge, Lewis Cty, NY | 57 | n/a | Agricultural plateau | 158 | n/a | 195 | 415 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |



| | | | | | | | | | (Turbine | |
|------|--|----------------------------------|---------------------------------|---------------------------------------|---|--|--------------------------------|------------------------------------|------------------------------------|---|
| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | Ht) % Targets Below Turbine Height | Reference |
| 2005 | Swallow Farm, PA | 58 | n/a | Forested ridge | 166 | n/a | n/a | 402 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2004 | Casselman, PA | 30 | n/a | Forested ridge | 174 | n/a | n/a | 436 | (125 m) 7% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2004 | Dans Mountain, MD | 34 | 318 | Forested ridge | 188 | 2-633 | 193 | 542 | (125 m) 11% | Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| 2006 | Villenova, Chautauqua Cty, NY | 36 | n/a | Great Lakes plain | 189 | 16-604 | 216 | 353 | (120 m) 9% | Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment. |
| 2004 | Prattsburgh, Steuben Cty, NY | 30 | 315 | Agricultural plateau | 193 | 12-474 | 188 | 516 | (125 m) 3% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| 2005 | Sheldon, Wyoming Cty, NY | 36 | 347 | Agricultural plateau | 197 | 43-529 | 213 | 422 | (120 m) 3% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | Ellenberg, Clinton Cty, NY | 57 | n/a | Great Lakes plain/ADK foothills | 197 | n/a | 162 | 333 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Prattsburgh- Italy, NY | 41 | n/a | Agricultural plateau | 200 | n/a | 177 | 365 | (125 m) 9% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Kibby, Franklin Cty, ME (Range 1) | 12 | 101 | Forested ridge | 201 | 12-783 | 196 | 352 | (125 m) 12% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2004 | Franklin, Pendleton Cty, WV | 34 | 349 | Forested ridge | 229 | 7-926 | 175 | 583 | (125 m) 8% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |



| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|------|---|----------------------------------|---------------------------------|-------------------------|---|--|--------------------------------|------------------------------------|---|--|
| 2006 | Wethersfield, Wyoming Cty, NY | 56 | n/a | Agricultural plateau | 256 | 31-701 | 208 | 344 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2006 | Centerville, Allegany Cty, NY | 57 | n/a | Agricultural plateau | 259 | 12-877 | 208 | 350 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2008 | Hounsfield, Jefferson Cty, NY | 60 | 674 | Great Lakes island | 281 | 64-835 | 207 | 298 | (125 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC. |
| 2005 | Fayette Cty, PA | 26 | n/a | Forested ridge | 297 | n/a | n/a | 426 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Stamford, Delaware Cty, NY | 48 | 418 | Forested ridge | 315 | 22-784 | 251 | 494 | (110 m) 3% | Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2006 | Somerset Cty, PA | 29 | n/a | Forested ridge | 316 | n/a | n/a | 374 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Laurel Mountain, Barbour Cty, WV | 20 | 212 | Forested ridge | 321 | 76-513 | 209 | 533 | (130 m) 6% | Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. |
| 2008 | Georgia Mountain, VT | 21 | n/a | Forested ridge | 326 | 56-700 | 230 | 371 | (120 m) 7% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind. |
| 2006 | Cape Vincent, Jefferson Cty, NY | 63 | 508 | Great Lakes plain | 346 | n/a | 209 | 490 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Errol, Coos County, NH | 29 | 232 | Forested ridge | 366 | 54 to 1234 | 223 | 343 | (125 m) 15% | Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |



| Year | Project Site | Number of Survey | Number of Survey | Landscape | Average Passage Rate | Range in Nightly | Average Flight | Average Flight Height | (Turbine Ht) % Targets | Reference |
|------|--|------------------------|------------------------|-------------------------|----------------------------|------------------------|-------------------|-----------------------------|---------------------------------|--|
| | | Nights | Hours | | (t/km/hr) | Passage Rates | Direction | (m) | Below Turbine Height | |
| 2007 | Lincoln, Penobscot Cty, ME | 22 | 231 | Forested ridge | 368 | 82-953 | 284 | 343 | (120 m) 13% | Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2005 | Preston Cty, WV | 26 | n/a | Forested ridge | 379 | n/a | n/a | 420 | (125 m) 10% | Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| 2005 | Jordanville, Herkimer Cty, NY | 38 | 404 | Agricultural plateau | 380 | 26-1019 | 208 | 440 | (125 m) 6% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Highland, VA | 58 | n/a | Forested ridge | 385 | n/a | n/a | 442 | (125 m) 12% | Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| 2005 | Clayton, Jefferson Cty, NY | 37 | 385 | Agricultural plateau | 418 | 83-877 | 168 | 475 | (150 m) 10% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2007 | Roxbury, Oxford Cty, ME | 20 | 220 | Forested ridge | 420 | 88-1006 | 227 | 365 | (130 m) 14% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC. |
| 2006 | Bedford Cty, PA | 29 | n/a | Forested ridge | 438 | n/a | n/a | 379 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Bliss, Wyoming Cty, NY | 8 | n/a | Agricultural plateau | 440 | 52-1392 | n/a | 411 | (125 m) 13% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Allegany, Cattaraugus Cty, NY | 46 | n/a | Forested ridge | 451 | n/a | 230 | 382 | (150 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Kibby, Franklin Cty, ME (Valley) | 5 | 13 | Forested ridge | 452 | 52-995 | 193 | 391 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |



| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|------|---|----------------------------------|---------------------------------|-------------------------|---|--|--------------------------------|------------------------------------|---|--|
| 2006 | Stetson, Washington Cty, ME | 12 | 77 | Forested ridge | 476 | 131- 1192 | 227 | 378 | (125 m) 13% | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2005 | Howard, Steuben Cty, NY | 39 | 405 | Agricultural plateau | 481 | 18-1434 | 185 | 491 | (125 m) 5% | Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2008 | Oakfield, Penobscot Cty, ME | 20 | n/a | Forested ridge | 501 | 116-945 | 200 | 309 | (125 m) 18% | Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2005 | Mars Hill, Aroostook Cty, ME | 18 | 117 | Forested ridge | 512 | 60-1092 | 228 | 424 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. |
| 2006 | Dutch Hill, Steuben Cty, NY | 21 | n/a | Agricultural plateau | 535 | n/a | 215 | 358 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Deerfield, Bennington Cty, VT | 32 | 324 | Forested ridge | 559 | 3-1736 | 221 | 395 | (100 m) 13% | Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2005 | Kibby, Franklin Cty, ME (Mountain) | 12 | 115 | Forested ridge | 565 | 109- 1107 | 167 | 370 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Lempster, Sullivan Cty, NH | 32 | 290 | Forested ridge | 620 | 133- 1609 | 206 | 387 | (125 m) 8% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2006 | Chateaugay, Franklin Cty, NY | 35 | 327 | Agricultural plateau | 643 | 38-1373 | 212 | 431 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2005 | Fairfield, Herkimer Cty, NY | 38 | 423 | Agricultural plateau | 691 | 116- 1351 | 198 | 516 | (145 m) 6% ¹ | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Munnsville, Madison Cty, NY | 31 | 292 | Agricultural plateau | 732 | 15-1671 | 223 | 644 | (118 m) 2% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |



| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|------|--------------------------------------|----------------------------------|---------------------------------|---------------------------------------|---|--|--------------------------------|------------------------------------|---|--|
| 2007 | New Creek, Grant Cty, WV | 20 | n/a | Forested ridge | 811 | 263- 1683 | 231 | 360 | (130 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC. |
| 2007 | Wolfe Island, Ontario, Canada* | n/a | n/a | Great Lakes island | n/a | n/a | 95 | 233 | (125m) 23% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Ellenberg, Clinton Cty, NY | 40 | n/a | Great Lakes plain/ADK foothills | 110 | n/a | 30 | 338 | (125 m) 20% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Sheldon, Wyoming Cty, NY | 38 | 272 | Agricultural plateau | 112 | 6-558 | 25 | 422 | (120 m) 6% | Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | Munnsville, Madison Cty, NY | 41 | 388 | Agricultural plateau | 160 | 6-1065 | 31 | 291 | (118 m) 25% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2005 | Sheffield, Caledonia Cty, VT | 20 | 180 | Forested ridge | 166 | 12-440 | 40 | 552 | (125 m) 6% | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2005 | Stamford, Delaware Cty, NY | 35 | 301 | Forested ridge | 210 | 10-785 | 46 | 431 | (110 m) 8% | Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2005 | Churubusco, Clinton Cty, NY | 39 | 310 | Great Lakes plain/ADK foothills | 254 | 3-728 | 40 | 422 | (120 m) 11% | Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Prattsburgh, Steuben Cty, NY | 20 | 183 | Agricultural plateau | 277 | 70-621 | 22 | 370 | (125 m) 16% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| 2005 | Deerfield, Bennington Cty, VT | 20 | 183 | Forested ridge | 404 | 74-973 | 69 | 523 | (100 m) 4% | Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |



| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|------|--|----------------------------------|---------------------------------|-------------------------|---|--|--------------------------------|------------------------------------|---|---|
| 2005 | Jordanville, Herkimer Cty, NY | 40 | 364 | Agricultural plateau | 409 | 26-1410 | 40 | 371 | (125 m) 21% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc. |
| 2005 | Franklin, Pendleton Cty, NY | 21 | 204 | Forested ridge | 457 | 34-1240 | 53 | 492 | (125 m) 11% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| 2005 | Clayton, Jefferson Cty, NY | 36 | 303 | Agricultural plateau | 460 | 71-1769 | 30 | 443 | (150 m) 14% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Dans Mountain, MD | 23 | 189 | Forested ridge | 493 | 63-1388 | 38 | 541 | (125 m) 15% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| 2005 | Fairfield, Herkimer Cty, NY | 40 | 369 | Agricultural plateau | 509 | 80-1175 | 44 | 419 | (145 m) 16% ¹ | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2006 | Kibby, Franklin Cty, ME (Range 1) | 10 | 80 | Forested ridge | 197 | 6-471 | 50 | 412 | (120 m) 22% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Deerfield, Bennington Cty, VT | 26 | 236 | Forested ridge | 263 | 5-934 | 58 | 435 | (100 m) 11% | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2006 | Centerville, Allegany Cty, NY | 42 | n/a | Agricultural plateau | 290 | 25-1140 | 22 | 351 | (125 m) 16% | Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006. |
| 2006 | Wethersfield, Wyoming Cty, NY | 44 | n/a | Agricultural plateau | 324 | 41-907 | 12 | 355 | (125 m) 19% | Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006. |



| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference | | | | | |
|------|---|----------------------------------|---------------------------------|-------------------------|---|--|--------------------------------|------------------------------------|---|--|--|--|--|--|--|
| 2006 | Mars Hill, Aroostook Cty, ME | 15 | 85 | Forested ridge | 338 | 76-674 | 58 | 384 | (120 m) 14% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. | | | | | |
| 2006 | Chateaugay, Franklin Cty, NY | 35 | 300 | Agricultural plateau | 360 | 54-892 | 48 | 409 | (120 m) 18% | Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. | | | | | |
| 2006 | Howard, Steuben Cty, NY | 42 | 440 | Agricultural plateau | 440 | 35-2270 | 27 | 426 | (125 m) 13% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. | | | | | |
| 2006 | Kibby, Franklin Cty, ME (Valley) | 2 | 14 | Forested ridge | 443 | 45-1242 | 61 | 334 | (120 m) n/a | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. | | | | | |
| 2006 | Kibby, Franklin Cty, ME (Mountain) | 6 | 33 | Forested ridge | 456 | 88-1500 | 67 | 368 | (120 m) 14% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. | | | | | |
| 2006 | Kibby, Franklin Cty, ME (Range 2) | 7 | 57 | Forested ridge | 512 | 18-757 | 86 | 378 | (120 m) 25% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. | | | | | |
| 2007 | Stetson, Washington Cty, ME | 21 | 138 | Forested ridge | 147 | 3-434 | 55 | 210 | (120 m) 22% | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. | | | | | |
| 2007 | Cape Vincent, Jefferson Cty, NY | 50 | 300 | Great Lakes plain | 166 | n/a | 34 | 441 | (125 m) 14% | Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America. | | | | | |
| 2007 | New Grange, Chautauqua Cty, NY | 41 | n/a | Great Lakes plain | 175 | n/a | 18 | 450 | (125 m) 13% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf | | | | | |
| 2007 | Laurel Mountain, Barbour Cty, WV | 20 | 197 | Forested ridge | 277 | 13-646 | 27 | 533 | (130 m) 3% | Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. | | | | | |



| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|------|-------------------------------------|----------------------------------|---------------------------------|-----------------------|---|--|--------------------------------|------------------------------------|---|---|
| 2007 | Errol, Coos County, NH | 30 | 212 | Forested ridge | 342 | 2 to 870 | 76 | 332 | (125 m) 14% | Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| 2007 | Villenova, Chautauqua Cty, NY | 40 | n/a | Great Lakes plain | 419 | 22-1190 | 10 | 493 | (120 m) 3% | Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment. |
| 2007 | Roxbury, Oxford Cty, ME | 20 | n/a | Forested ridge | 539 | 137- 1256 | 52 | 312 | (130) 18% | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC. |
| 2007 | Lempster, Sullivan Cty, NH | 30 | 277 | Forested ridge | 542 | 49-1094 | 49 | 358 | (125 m) 18% | Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2008 | Lincoln, Penobscot Cty, ME | 20 | 189 | Forested ridge | 247 | 40-766 | 75 | 316 | (120 m) 13% | Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2008 | Allegany, Cattaraugus Cty, NY | 30 | 275 | Forested ridge | 268 | 53-755 | 18 | 316 | (150 m) 19% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2008 | Oakfield, Penobscot Cty, ME | 20 | 194 | Forested ridge | 498 | 132-899 | 33 | 276 | (120 m) 21% | Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2008 | Hounsfield, Jefferson Cty, NY | 42 | 379 | Great Lakes island | 624 | 74-1630 | 51 | 319 | (125 m) 19% | Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC. |
| 2008 | New Creek, Grant Cty, WV | 20 | n/a | Forested ridge | 1020 | 289- 2610 | 30 | 354 | (130 m) 13% | Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC. |

Note:

¹ The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.





Appendix B

Raptor Survey Data Tables



| Appendix B Table 1 | . Daily total | s of raptor s | species obs | erved and d | aily passa 2009. | ge rates at t | he Kingdom | Communit | y Wind Proj | ect during | Spring |
|------------------------|---------------|---------------|-------------|-------------|---------------------|---------------|------------|-----------|-------------|------------|------------------|
| Species | 4/15/2009 | 4/16/2009 | 4/24/2009 | 4/25/2009 | 5/5/2009 | 5/15/2009 | 5/21/2009 | 5/22/2009 | 5/26/2009 | 6/1/2009 | Entire Season |
| American kestrel | | | | 2 | | | | | | | 2 |
| bald eagle | | | | 1 | | | | | | | 1 |
| broad-winged hawk | | | 1 | 7 | | | | | 1 | | 9 |
| Cooper's hawk | | | | 2 | 2 | 1 | | | | | 5 |
| merlin | | | | 1 | | | | | | | 1 |
| osprey | | | | 2 | | | | | | | 2 |
| red-shouldered hawk | | | | 3 | | | | | | | 3 |
| red-tailed hawk | 12 | 2 | 5 | 5 | 2 | 2 | | 2 | 2 | 2 | 34 |
| sharp-shinned hawk | 2 | 1 | 1 | 2 | | | | | | | 6 |
| turkey vulture | 7 | 11 | 5 | 5 | 13 | 4 | | 2 | 3 | 2 | 52 |
| unidentified accipiter | | | | 2 | 5 | | | | | | 7 |
| unidentified buteo | | 1 | | 2 | 3 | | 1 | | | | 7 |
| unidentified raptor | | 1 | 1 | 2 | | | 1 | | | | 5 |
| Daily Totals | 21 | 16 | 13 | 36 | 25 | 7 | 2 | 4 | 6 | 4 | 134 |
| Daily Passage Rates | 2.63 | 2.00 | 1.63 | 4.50 | 3.57 | 1.00 | 0.29 | 0.57 | 0.86 | 0.57 | 1.81 |



| Appendix B Table 2. Ho | urly summar | y of raptor ob | servations at | the Kingdo | m Commur | nity Wind P | roject durii | ng Spring | 2009. |
|------------------------|----------------|-----------------|-----------------|----------------|---------------|---------------|---------------|---------------|-------|
| Species | 9:00- 10:00 | 10:00- 11:00 | 11:00- 12:00 | 12:00- 1:00 | 1:00- 2:00 | 2:00- 3:00 | 3:00- 4:00 | 4:00- 5:00 | Total |
| American kestrel | | | 1 | | 1 | | | | 2 |
| bald eagle | | | | | 1 | | | | 1 |
| broad-winged hawk | | | 2 | | 2 | 1 | 3 | 1 | 9 |
| Cooper's hawk | | 2 | 1 | 1 | | | 1 | | 5 |
| merlin | | | | | | | 1 | | 1 |
| osprey | | 1 | | | 1 | | | | 2 |
| red-shouldered hawk | | | 1 | 1 | | 1 | | | 3 |
| red-tailed hawk | 1 | 10 | 8 | | 7 | 3 | 4 | 1 | 34 |
| sharp-shinned hawk | 1 | | 2 | 1 | | 1 | 1 | | 6 |
| turkey vulture | | 8 | 8 | 9 | 3 | 8 | 14 | 2 | 52 |
| unidentified accipiter | | 4 | 1 | | 2 | | | | 7 |
| unidentified buteo | 1 | 2 | 1 | 1 | | 2 | | | 7 |
| unidentified raptor | | | | 1 | 2 | 1 | 1 | | 5 |
| Hourly totals | 3 | 27 | 25 | 14 | 19 | 17 | 25 | 4 | 134 |

TOTAL



Appendix B Table 3. Number of individuals of species observed within the Kingdom Community Project boundary above or below 135 m, Spring 2009. less than 125 m 135 m or greater **Species** Total American kestrel broad-winged hawk Cooper's hawk merlin osprey red-shouldered hawk red-tailed hawk sharp-shinned hawk turkey vulture unidentified accipiter unidentified buteo unidentified raptor



| | | Appendi | x 4 Table 4. Summary of | publicly availab | ole raptor su | rvey res | ults for | spring wir | nd projects | (June 1, | 2009). | |
|------|--------|-------------------------|----------------------------------|-------------------------|------------------|---------------------|----------------------|---------------------|------------------------------|---------------------------|---|--------------------------|
| Year | Season | Project | Project Location | Landscape | Survey Period | # Survey Days | # Survey Hours | # Birds Observed | # Species Observed | Passage Rate (b/hr) | % Below Turbine Height | Citation |
| 1999 | Spring | Wethersfield | Wethersfield, Wyoming Cty, NY | Agricultural plateau | 4/20-5/24 | 24 | 97 | 348 | 12 | 3.6 | n/a (23 m mean flight height) | Cooper and Mabee 1999 |
| 2003 | Spring | Westfield | Westfield, Chautaugua, NY | Great Lakes shore | 4/16-5/15 | 50 | 101 | 2578 | 17 | 25.6 | n/a (278 m mean flight height) | Cooper et al.2004 |
| 2005 | Spring | Cohocton/ Dutch Hill | Cohocton, Steuben Cty, NY | Agricultural plateau | Spring | 10 | 60 | 164 | 11 | 2.7 | (125 m) 77% | Woodlot 2006a |
| 2005 | Spring | Dairy Hills | Dairy Hills, Clinton Cty, NY | Great Lakes Shore | 4/15-4/26 | 5 | 20 | 50 | 7 | 3.0 | n/a | Mabee et al. 2005 |
| 2005 | Spring | Horse Creek | Clayton, Jefferson Cty, NY | Agricultural plateau | 3/30-5/7 | 10 | 58 | 700 | 14 | 12.1 | (150 m) 61% | Woodlot 2005a |
| 2005 | Spring | Marble River | Churubusco, Clinton Cty, NY | Great Lakes plain | Spring | 10 | 60 | 170 | 11 | 2.8 | (120 m) 69% | Woodlot 2005b |
| 2005 | Spring | Prattsburgh | Prattsburgh, Steuben Cty , NY | Agricultural plateau | Spring | 10 | 60 | 314 | 15 | 5.2 | (125 m) 83% | Woodlot 2005c |
| 2005 | Spring | West Hill | Munnsville, Madison Cty, NY | Agricultural plateau | 4/5-5/16 | 10 | 60 | 375 | 12 | 6.3 | (118 m) 78% | Woodlot 2005d |
| 2005 | Spring | Deerfield | Deerfield, Bennington Cty, VT | Forested ridge | 4/9-4/29 | 7 | 42 | 44 | 11 (for both sites combined) | 1.1 | (125 m) 83% (at both sites combined) | Woodlot 2005e |
| 2005 | Spring | Deerfield | Deerfield, Bennington Cty, VT | Forested ridge | 4/9-4/29 | 7 | 42 | 38 | 11 (for both sites combined) | 0.9 | (125 m) 83% (at both sites combined) | Woodlot 2005e |
| 2005 | Spring | Sheffield | Sheffield, Caledonia Cty, VT | Forested ridge | April - May | 10 | 60 | 98 | 10 | 1.6 | (125 m) 69% | Woodlot 2006b |
| 2006 | Spring | Mars Hill | Mars Hill, Aroostook Cty, ME | Forested ridge | 4/12-5/18 | 10 | 60 | 64 | 9 | 1.1 | (120 m) 48% | Woodlot 2006c |
| 2006 | Spring | Lempster | Lempster, Sullivan Cty, NH | Forested ridge | Spring | 10 | 78 | 102 | n/a | 1.3 | 125 m (18%) | Woodlot 2007a |



| | Appendix 4 Table 4. Summary of publicly available raptor survey results for spring wind projects (June 1, 2009). | | | | | | | | | | | | |
|------|--|-------------|-------------------------------------|----------------------|------------------|---------------------|----------------------|---------------------|-----------------------|---------------------------|------------------------------|------------------|--|
| Year | Season | Project | Project Location | Landscape | Survey Period | # Survey Days | # Survey Hours | # Birds Observed | # Species Observed | Passage Rate (b/hr) | % Below Turbine Height | Citation | |
| 2006 | Spring | Howard | Howard, Steuben Cty, NY | Agricultural plateau | 4/3-5/19 | 9 | 53 | 260 | 11 | 5.0 | (125 m) 64% | Woodlot 2006d | |
| 2007 | Spring | Stetson | Stetson, Penobscot Cty, ME | Forested ridge | 4/26-5/4 | 9 | 59 | 34 | 10 | 0.6 | (125 m) 65% | Woodlot 2007b | |
| 2007 | Spring | Laurel | Laurel Mountain, Preston Cty, WV | Forested ridge | 3/30-5/17 | 10 | 63.75 | 266 | 12 | 4.17 | (125 m) 55% | Stantec 2008b | |
| 2008 | Spring | Oakfield | Oakfield, Aroostock Cty, Me | Agricultural plateau | 4/25-5/30 | 12 | 79 | 58 | 9 | 0.7 | (120 m) 80% | Stantec 2008c | |
| 2008 | Spring | Record Hill | Roxbury, Oxford Cty, ME | Forested ridge | 3/11-5/27 | 15 | 97 | 118 | 12 | 1.2 | n/a | Stantec 2008d | |
| 2008 | Spring | Rollins | Lincoln, Penobscot Cty, ME | Forested ridge | 4/3-6/3 | 15 | 108 | 122 | 12 | 1.1 | (125 m) 76% | Stantec 2008e | |
| 2008 | Spring | New Creek | Greenland, Grant Cty, WV | Forested ridge | 3/21-5/14 | 10 | 68 | 212 | 9 | 3.12 | (125 m) 68% | Stantec 2008f | |



Appendix C

Breeding Bird Survey Data Tables



Appendix C Table 1A. Total number of species and individuals detected, and distance from observer at 17 point count locations during two survey periods – Kingdom Community Wind, Summer 2009*

| at 17 point count locati | The during two survey | y perious | | | inity willu, s | Julillier 2009 | | | | |
|-----------------------------|--|-----------|--------|-------|----------------|----------------|--|--|--|--|
| Common nome | Coiontifio nomo | 0.50 | 50-100 | > 100 | Flyevene | Crond Total | | | | |
| Common name | Scientific name | 0-50 m | m | m | Flyovers | Grand Total | | | | |
| American crow | Corvus brachyrhynchos | | | 1 | | 1 | | | | |
| American redstart | Setophaga ruticilla | | 1 | | | 1 | | | | |
| Bay breasted warbler | Dendroica castanea | 1 | ! | | | 1 | | | | |
| Black-and-white warbler | Mniotilta varia | 3 | 1 | 1 | | 5 | | | | |
| Blackburnian warbler | Dendroica fusca | 3 | 1 | | | 1 | | | | |
| | | 2 | I | | | 2 | | | | |
| Black-capped chickadee | Poecile atricapilla | 2 | 4 | 4 | | | | | | |
| Blackpoll warbler | Dendroica striata | 10 | 4 | 1 | | 15 | | | | |
| Black-throated blue warbler | Dendroica | 9 | 8 | 4 | | 21 | | | | |
| Black-throated green | caerulescens | 9 | 0 | 4 | | 21 | | | | |
| warbler | Dendroica virens | 1 | 5 | 1 | | 7 | | | | |
| Blue jay | Cyanocitta cristata | 1 | | 1 | | 2 | | | | |
| Canada warbler | Wilsonia canadensis | 3 | | ' | | 3 | | | | |
| Chimney swift | Chaetura pelagica | 3 | | | 1 | <u>3</u> 1 | | | | |
| | | 5 | 1 | 12 | l | 21 | | | | |
| Dark-eyed junco | Junco hyemalis | | 4 | 12 | | | | | | |
| Golden-crowned kinglet | Regulus satrapa | 3 | 1 | | | 4 | | | | |
| Hermit thrush | Catharus guttatus | | 1 | 5 | | 6 | | | | |
| Magnolia warbler | Dendroica magnolia | 3 | 4 | 2 | | 9 | | | | |
| Mourning dove | Zenaida macroura | | | 2 | | 2 | | | | |
| Mourning warbler | Oporornis philadelphia | | 1 | | | 1 | | | | |
| Nashville warbler | Vermivora ruficapilla | 1 | 1 | | | 2 | | | | |
| Ovenbird | | 1 | 3 | 6 | | 10 | | | | |
| | Seiurus aurocapillus | 2 | 1 | 4 | | 7 | | | | |
| Red-eyed vireo | Vireo olivaceus | | ļ | 4 | | | | | | |
| Rose-breasted grosbeak | Pheucticus Iudovicianus | 1 | | | | 1 | | | | |
| Scarlet tanager | Piranga olivacea | | | 3 | | 3 | | | | |
| Swainson's thrush | Catharus ustulatus | | 4 | 4 | | 8 | | | | |
| Unidentified passerine | n/a | 1 | | 1 | | 2 | | | | |
| Unidentified woodpecker | n/a | ı | | 1 | | 1 | | | | |
| Offideritified Woodpecker | Catharus | | | | | ı | | | | |
| Veery | fuscescens | | | 1 | | 1 | | | | |
| White-breasted nuthatch | Sitta carolinensis | | 1 | • | | <u>.</u> 1 | | | | |
| White-throated sparrow | Zonotrichia albicollis | 10 | 8 | 12 | | 30 | | | | |
| vvinto tinoateu spanow | Troglodytes | 10 | U | 14 | | | | | | |
| Winter wren | troglodytes | 4 | 3 | 5 | | 12 | | | | |
| | Empidonax | - | - | - | | | | | | |
| Yellow-bellied flycatcher | flaviventris | 1 | | | | 1 | | | | |
| Yellow-bellied | | | | | | | | | | |
| sapsucker | Sphyrapicus varius | 4 | 1 | | | 5 | | | | |
| Yellow-rumped warbler | Dendroica coronata | 7 | | 1 | | 8 | | | | |
| Grand Total | | 73 | 53 | 68 | 1 | 195 | | | | |
| | *Numbers largely represent singing males but also include male and some female individuals that were | | | | | | | | | |

*Numbers largely represent singing males but also include male and some female individuals that were visually detected.



| Appendix C Table 1B. Too observer at 10 control p | | • | |
|---|--|---|-------|
| | | | Grand |

| observer at 10 control p | omi count locations du | ilig two s | ui vey perio | us - Sullill | IEI 2003 |
|------------------------------|----------------------------|------------|--------------|--------------|----------------|
| Common name | Scientific name | 0-50 m | 50-100 m | > 100 m | Grand Total |
| | Corvus | | | 4 | 1 |
| American crow | brachyrhynchos | | | 1 | 1 |
| American robin | Turdus migratorius | | 1 | 1 | 2 |
| Black-and-white warbler | Mniotilta varia | | 1 | | 1 |
| Blackpoll warbler | Dendroica striata | 5 | 2 | | 7 |
| Black-throated blue warbler | Dendroica caerulescens | 3 | 2 | 2 | 7 |
| Black-throated green warbler | Dendroica virens | 7 | 6 | 4 | 17 |
| Blue jay | Cyanocitta cristata | 1 | | | 1 |
| Canada warbler | Wilsonia canadensis | 2 | | 1 | 3 |
| Dark-eyed junco | Junco hyemalis | 1 | 3 | 3 | 7 |
| Golden-crowned kinglet | Regulus satrapa | | 1 | | 1 |
| Hermit thrush | Catharus guttatus | | 1 | 3 | 4 |
| Magnolia warbler | Dendroica magnolia | 3 | 1 | | 4 |
| Nashville warbler | Vermivora ruficapilla | 1 | | | 1 |
| Ovenbird | Seiurus aurocapillus | | 3 | 10 | 13 |
| Red-eyed vireo | Vireo olivaceus | | 2 | 6 | 8 |
| Scarlet tanager | Piranga olivacea | | | 2 | 2 |
| Swainson's thrush | Catharus ustulatus | | 2 | 3 | 5 |
| White-throated sparrow | Zonotrichia albicollis | 4 | 4 | 4 | 12 |
| Winter wren | Troglodytes troglodytes | | 2 | | 2 |
| Yellow-bellied flycatcher | Empidonax flaviventris | | 1 | | 1 |
| Yellow-bellied sapsucker | Sphyrapicus varius | 4 | | | 4 |
| Yellow-rumped warbler | Dendroica coronata | 2 | 1 | | 3 |
| Grand Total | | 33 | 33 | 40 | 106 |

*Numbers largely represent singing males but also include male and some female individuals that were visually detected.



| Appendix C Table 2A. | Total number of observations, relative abundance, and frequency of |
|----------------------|--|
| species at 17 pc | int count locations during two survey periods - Summer 2009 |

| | Dec | iduous forest | (8 points) | C | onifer forest (6 | points) |
|--|--------------------|---------------------------------|------------------------|--------------------|---------------------------------|------------------------|
| Species | Total ^a | Relative abundance ^b | Frequency ^c | Total ^a | Relative abundance ^b | Frequency ^c |
| American redstart | 1 | 0.06 | 13% | | 0.00 | 0% |
| Bay-breasted warbler | 1 | 0.06 | 13% | | 0.00 | 0% |
| Black-and-white warbler | 2 | 0.13 | 25% | 1 | 0.08 | 17% |
| Blackburnian warbler | | 0.00 | 0% | | 0.00 | 0% |
| Black-capped chickadee | | 0.00 | 0% | 2 | 0.17 | 33% |
| Blackpoll warbler | 2 | 0.13 | 25% | 8 | 0.67 | 67% |
| Black-throated blue warbler | 11 | 0.69 | 88% | 2 | 0.17 | 17% |
| Black-throated green warbler | 5 | 0.31 | 63% | | 0.00 | 0% |
| Blue jay | 1 | 0.06 | 13% | | 0.00 | 0% |
| Canada warbler | | 0.00 | 0% | 3 | 0.25 | 50% |
| Dark-eyed junco | 3 | 0.19 | 25% | 5 | 0.42 | 67% |
| Golden-crowned kinglet | | 0.00 | 0% | 4 | 0.33 | 67% |
| Hermit thrush | | 0.00 | 0% | 1 | 0.08 | 17% |
| Magnolia warbler | | 0.00 | 0% | 6 | 0.50 | 50% |
| Mourning warbler | | 0.00 | 0% | | 0.00 | 0% |
| Nashville warbler | | 0.00 | 0% | 1 | 0.08 | 17% |
| Ovenbird | 4 | 0.25 | 38% | | 0.00 | 0% |
| Red-eyed vireo | 2 | 0.13 | 25% | 1 | 0.08 | 17% |
| Rose-breasted grosbeak | 1 | 0.06 | 13% | | 0.00 | 0% |
| Swainson's thrush | | 0.00 | 0% | 4 | 0.33 | 50% |
| Unidentified passerine | 1 | 0.06 | 13% | | 0.00 | 0% |
| White-breasted nuthatch | | 0.00 | 0% | 1 | 0.08 | 17% |
| White-throated sparrow | 4 | 0.25 | 38% | 9 | 0.75 | 83% |
| Winter wren | 2 | 0.13 | 25% | 4 | 0.33 | 50% |
| Yellow-bellied flycatcher | | 0.00 | 0% | 1 | 0.08 | 17% |
| Yellow-bellied sapsucker | 4 | 0.25 | 50% | 1 | 0.08 | 17% |
| Yellow-rumped warbler | 2 | 0.13 | 13% | 3 | 0.25 | 33% |
| Grand Total | 46 | | | 57 | | |
| Relative abundance | 2.88 | | | 4.75 | | |
| Species richness | 16 | | | 18 | | |
| Range of species richness among points | 2 to 7 | | | 3 to 9 | | |
| Shannon Diversity Index | 2.50 | | | 2.62 | | |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

(continued below)

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.



| Appendix C Table 2A. Total number of observations, relative abundance, and |
|--|
| frequency of species at 17 point count locations during two survey periods - |
| Summer 2009 (continued) |

| Suii | nner 2009 (con | duous/conifer mix | (3 noints) |
|------------------------------|--------------------|------------------------|------------------------|
| | Deci | Relative | (5 points) |
| Species | Total ^a | abundance ^b | Frequency ^c |
| American redstart | | 0.00 | 0% |
| Bay-breasted warbler | | 0.00 | 0% |
| Black-and-white warbler | 1 | 0.17 | 33% |
| Blackburnian warbler | 1 | 0.17 | 33% |
| Black-capped chickadee | | 0.00 | 0% |
| Blackpoll warbler | 4 | 0.67 | 67% |
| Black-throated blue warbler | 4 | 0.67 | 67% |
| Black-throated green warbler | 1 | 0.17 | 33% |
| Blue jay | | 0.00 | 0% |
| Canada warbler | | 0.00 | 0% |
| Dark-eyed junco | 1 | 0.17 | 33% |
| Golden-crowned kinglet | | 0.00 | 0% |
| Hermit thrush | | 0.00 | 0% |
| Magnolia warbler | 1 | 0.17 | 33% |
| Mourning warbler | 1 | 0.17 | 33% |
| Nashville warbler | 1 | 0.17 | 33% |
| Ovenbird | | 0.00 | 0% |
| Red-eyed vireo | | 0.00 | 0% |
| Rose-breasted grosbeak | | 0.00 | 0% |
| Swainson's thrush | | 0.00 | 0% |
| Unidentified passerine | | 0.00 | 0% |
| White-breasted nuthatch | | 0.00 | 0% |
| White-throated sparrow | 5 | 0.83 | 100% |
| Winter wren | 1 | 0.17 | 33% |
| Yellow-bellied flycatcher | | 0.00 | 0% |
| Yellow-bellied sapsucker | | 0.00 | 0% |
| Yellow-rumped warbler | 2 | 0.33 | 67% |
| Grand Total | 23 | | |
| Relative abundance | 3.83 | | |
| Species richness | 12 | | |
| Range of species richness | | | |
| among points | 3 to 9 | | |
| Shannon Diversity Index | 2.24 | | |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.



| Appendix C Table 2B. | Total number of observations, relative abundance, and frequency of species |
|----------------------|--|
| at 8 contro | I point count locations during two survey periods - Summer 2009 |

| Dec | iduous forest | (5 points) | Decid | uous/conifer m | ix (3 points) |
|--------------------|--|----------------------------|--|--|---|
| Total ^a | Relative abundance ^b | Frequency ^c | Total ^a | Relative abundance ^b | Frequency ^c |
| 1 | 0.10 | 20% | | 0.00 | 0% |
| 1 | 0.10 | 20% | | 0.00 | 0% |
| 1 | 0.10 | 20% | 6 | 1.00 | 100% |
| 4 | 0.40 | 40% | 1 | 0.17 | 33% |
| 10 | 1.00 | 900/ | 2 | 0.50 | 100% |
| | | | 3 | | 0% |
| • | | | | | 0% |
| | | | 4 | | |
| | | | | | 100% |
| 4 | | | 1 | | 33% |
| 1 | | | _ | | 0% |
| | | | | | 100% |
| | | | 1 | | 33% |
| | | | | | 0% |
| 2 | | | | | 0% |
| | | 0% | | 0.33 | 67% |
| 2 | 0.20 | 20% | | 1.00 | 100% |
| | 0.00 | 0% | 2 | 0.33 | 67% |
| | 0.00 | 0% | 1 | 0.17 | 33% |
| 4 | 0.40 | 60% | | 0.00 | 0% |
| | 0.00 | 0% | 3 | 0.50 | 67% |
| 32 | | | 34 | | |
| 3.20 | | | 5.67 | | |
| 12 | | | 12 | | |
| | | | | | |
| | | | | | |
| | | <u> </u> | | | |
| | Total ^a 1 1 1 4 10 1 2 1 3 2 2 4 32 3.20 12 3 to 5 2.17 | Total Relative abundance | Deciduous forest (5 points) Relative abundance ^b Frequency ^c 1 0.10 20% 1 0.10 20% 1 0.10 20% 4 0.40 40% 10 1.00 80% 1 0.10 20% 2 0.20 20% 0.00 0% 0 1 0.10 20% 0.00 0% 0 0.00 0% 0 0.00 0% 0 2 0.20 40% 2 0.20 20% 0.00 0% 0 2 0.20 20% 0.00 0% 0 4 0.40 60% 0.00 0% 0 32 3.20 12 3 to 5 2.17 0 | Deciduous forest (5 points) Deciduous Frequency Totala abundance abundance b Frequency C Totala | Totala abundanceb Relative abundanceb Frequencyc Totala abundanceb Relative abundanceb 1 0.10 20% 0.00 1 0.10 20% 6 1.00 1 0.10 20% 6 1.00 4 0.40 40% 1 0.17 10 1.00 80% 3 0.50 1 0.10 20% 0.00 2 0.20 20% 0.00 2 0.20 20% 0.00 2 0.20 20% 0.00 3 0.00 0% 4 0.67 4 0.17 0.00 0% 4 0.67 0.00 0% 4 0.67 0.00 < |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.



Appendix D

Acoustic Survey Data Tables



| The color The | Appendix D | Table 1. Su | ımmary of ac | oustic bat dat | a and w eathe | | survey night | at the North | Tower Detec | tor, 2009. | | Inna | | |
|--|----------------------|-------------|--|----------------|---------------|-------|--------------|--------------|-------------|------------|--|------|----------|-----|
| The color of the | | | | BBSH | | HB | MYSP | | RBTB | l | | UNKN | | |
| 941900 1 | | Derational? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastern red | Tri-colored | RBTB | HFUN | LFUN | UNKN | |
| 0.00000 1 | 04/18/09 | 1 | | | | | | | | | | | | 0 |
| 042000 1 | | | | | | | | | | | | | | |
| 042000 1 | 04/20/09 | | | | | | | | | | | | | |
| 000000 1 | | | | | | | | | | | | | | |
| 000000 1 | | | | | | | | | | | | | | |
| 042000 1 | | | | | | | | | | | | | | 0 |
| 040000 1 | 04/26/09 | | | | | | | | | | | | | |
| 040000 1 | | | | | | | | | | | | | | |
| 0,000000 1 | | | | | | | | | | | | | | |
| 060000 1 | | | | | | | | | | | 1 | | | |
| 060000 1 | | | | | | | | | | | | | | |
| 0,000,000 1 | 05/03/09 | 1 | | | | | | | | | | | | |
| 0,000000 1 | | | | - | | | | | - | - | 1 | - | - | |
| 0000000 1 | | | | | | | | | | | | | | |
| 0001000 1 | 05/07/09 | 1 | | | | | | | | | | | | |
| 0001000 1 | 05/08/09 05/09/09 | 1 1 | 1 | | | | 1 | | | l | 1 | | | |
| 061-1000 1 | 05/10/09 | 1 | | | | | | | | | | | | 0 |
| 051400 1 | | | | | | | | | | | l | | | |
| 0514500 1 | | | 1 | | | | 1 | | | l | 1 | | | |
| 05/1970 1 | 05/14/09 | 1 | | | | | | | | | 2 | | | 2 |
| CG17700 1 | | | | - | | | | | — | | | - | — | |
| OFFICE 1 OFFICE OFFICE | 05/17/09 | 1 | | | | | | | | | | | | 0 |
| | | | | | | | ļ | | | | <u> </u> | | | |
| SSC-100 | 05/19/09 | | | | | | | | | | | | | |
| 1 | 05/21/09 | 1 | | | | | | | | | 1 | | | 1 |
| 050-0500 1 | | | | | | | | | | | | | | |
| 0050000 1 | | | | | | | | | | | | 1 | | |
| 0657200 | 05/25/09 | 1 | | | | | | | | | | | | 0 |
| 0.052000 | 05/26/09 | | | | | | | | | | | | | |
| | | | | | | | | | | | | 1 | | |
| 069100 | | | | | | | | | | | | | 1 | |
| 0601000 1 | | | | | | | | | | | | | | |
| 0603402 | 06/01/09 | 1 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 0000000 | | | | | | | | | | | | | | |
| 0667000 1 | | | 2 | | | | | | | | | | | |
| December 1 | | | | | | | 2 | | | | 2 | | | |
| 0691100 | 06/08/09 | 1 | | | | | 2 | | | | 16 | | | 18 |
| 0691100 1 | | | | | | | | | | | | 1 | | |
| 061300 1 | | | | | | | | | | | | | | |
| 0691500 1 | | | | | 10 | | 3 | | | | 3 | 16 | | |
| 06 1 | | | | | 2 | | 2 | | | | | 2 | | |
| 0691700 1 | 06/15/09 | 1 | | | | | | | | | | | | 0 |
| 061900 1 | | | | - | | | 1 | | - | - | | 1 | - | |
| 061909 1 | 06/18/09 | | | | | | <u> </u> | | | | | | | 0 |
| 0682200 1 | 06/19/09 | | | | | | | - | | | l - | | | |
| 062200 1 | | | | | | | | | | | | 1 | | |
| 062400 1 | | | | | | | | | | | | | | 0 |
| 062500 1 15 5 | | | 3 | | | | | | | - | 2 | | 1 | |
| 062606 1 | 06/25/09 | 1 | 15 | | | | | | | | | | L . | 39 |
| 0622909 1 | 06/26/09 | 1 | <u> </u> | | | | 1 | | | | | | | |
| 062300 | | | | | 1 | | 10 | | | | | 1 | | |
| 0 0 0 0 0 0 0 0 0 0 | 06/29/09 | 1 | | | | | | | | | | | | 5 |
| 0707409 1 | | | | | | | | | | - | | | | |
| 0771409 1 | 07/02/09 | 1 | | | | | | | | | | | | 0 |
| 0.000 | | | | | | | | | | | 1 | | | |
| | | | 1 | | | | | | | | 1 | | | |
| 0771809 | 07/06/09 | 1 | | | 11 | | 12 | | | | | 7 | | 60 |
| 0771009 | 07/07/09 | | 1 | | 2 | | 1 | | | - | 3 | | | |
| 07/1009 1 | 07/09/09 | 1 | | | | | 17 | | | | 282 | 2 | | 304 |
| 07/1209 1 | | | <u> </u> | | _ | | | | | | | | | |
| 07/14/09 1 | | | | | | | | | | | | 1 | | |
| 0771409 1 | 07/13/09 | 1 | | | | | | | | | | | | 0 |
| 0771609 1 | 07/14/09 | | 2 | | A | | 4 | | | | 1.40 | e | | |
| 07/17/09 1 1 6 16 17 07/18/09 1 6 90 96 07/19/09 1 6 6 90 96 62 62 07/20/09 1 6 105 14 31 35 191 | | | - | | - | | | | | | | | | |
| 07/19/09 1 62 62 07/20/09 1 6 105 14 31 35 191 | 07/17/09 | 1 | | | | | 1 | | | | 16 | | | 17 |
| 07/20/09 1 6 105 14 31 35 191 | | | - | | | | 6 | | | - | | | | |
| 07/21/09 1 4 4 | 07/20/09 | 1 | 6 | | 105 | | 14 | | | | 31 | 35 | | 191 |
| | 07/21/09 | 1 | | | | | | | | | 4 | | | 4 |



| Ву | Guild | | BBSH | | НВ | MYSP | | RBTB | | | UNKN | | Total |
|----------|--------|-----|------|-----|----------|----------|---|------|----------|--|------|---|---------|
| | | | 264 | | 0 | 188 | | 6 | <u>`</u> | | 1466 | | 1924 |
| | pecies | 73 | 0 | 191 | 0 | 188 | 6 | 0 | 0 | 1313 | 149 | 4 | |
| 10/17/09 | | | | | | | | | | | | | 0 |
| 10/16/09 | | | | | | | | | | | | | 0 |
| 10/15/09 | | | | | | | | | | | | | 0 |
| 10/14/09 | 1 | | | | | | | | | | | | 0 |
| 10/12/09 | | | | | | | | | | | | | 0 |
| 10/11/09 | 1 | | | | | | | | 1 | 1 | | | 0 |
| 10/10/09 | | | | | - | | | | - | | | | 0 |
| 10/09/09 | | | | | | | | | ļ | 1 | | | 1 |
| 10/08/09 | 1 | | | | | | | | | | | | 0 |
| 10/07/09 | 1 | | | | | | | | | | | | 0 |
| 10/06/09 | 1 | | | | | | | | | | | | 0 |
| 10/04/09 | | | | | | <u> </u> | | | | | | | 0 |
| 10/03/09 | | | | | | 1 | | | - | 1 | | | 1 |
| 10/02/09 | | | | | - | | | | | <u> </u> | | | 0 |
| 10/01/09 | 1 | | | | | | | | | | | | 0 |
| 09/30/09 | 1 | | | | | | | | | | | | 0 |
| 09/29/09 | 1 | | | | | | | | | | | | 0 |
| 09/28/09 | | | | | | | | | | | | | ō |
| 09/26/09 | 1 | | | | | | | | | - '- | | | 0 |
| 09/25/09 | 1 | | | 2 | - | — | | | - | 1 | | | 2 |
| 09/24/09 | 1 | | | ^ | | | | | ļ | 1 | | | 1 |
| 09/23/09 | 1 | | | | | 3 | | | | 1 | | | 4 |
| 09/22/09 | 1 | | | | | 1 | | | | 1 | | | 2 |
| 09/21/09 | | | | | | 1 | | | 1 | | | | 1 |
| 09/20/09 | | | | 1 | | | | | | 1 | | | 2 |
| 09/18/09 | 1 | | | | | | | | | | | | 0 |
| 09/17/09 | 1 | 2 | | | | - | | | | | | | 1 2 |
| 09/16/09 | 1 | | | | - | | | | | | | | 0 |
| 09/15/09 | 1 | | | | | | | | | 2 | | | 2 |
| 09/14/09 | 1 | 1 | | | | | 1 | | | 4 | | | 6 |
| 09/13/09 | 1 | 5 | | | | | | | | | | | 5 |
| 09/11/09 | 1 | | | | | 1 | 1 | | | 3 | | | 5 |
| 09/10/09 | 1 | | | | | 1 | | | | 3 | | | 3 |
| 09/09/09 | 1 | 1 | | | - | — | | | - | 2 | | | 3 |
| 09/08/09 | 1 | 1 | | | | | | | | _ | | | 1 |
| 09/07/09 | 1 | | | | | 1 | | | | 3 | | | 4 |
| 09/06/09 | 1 | 1 | | | | | | | | | | | 1 |
| 09/05/09 | 1 | 1 | | | | 1 | | | | | | | 2 |
| 09/04/09 | 1 | | | | | 1 | | | | 1 | | 1 | 3 |
| 09/03/09 | | | | | | 4 | | | | 2 | | | 6 |
| 09/02/09 | | | | | | 1 | | | | 4 | | | 5 |
| 09/01/09 | | | | | | 1 | | | | 6 | | | 7 |
| 08/30/09 | | - | | | - | | 2 | | | | | | 2 |
| 08/30/09 | 1 | 1 | | | | | | | | 1 | 2 | | 4 |
| 08/28/09 | | | | | | 1 | | | | 2 | | | 0 |
| 08/27/09 | 1 | | | | | - 1 | | | | 2 | 4 | | 6 3 |
| 08/26/09 | | 1 | | | | 1 | | | | 1 | | | 3 |
| 08/25/09 | 1 | 1 | | | | 1 | | | | 3 | 1 | 1 | 7 |
| 08/24/09 | 1 | | | | | 3 | | | | 16 | 1 | | 20 |
| 08/23/09 | 1 | 1 | | | | | | | | 2 | | | 3 |
| 08/22/09 | 1 | 2 | | | | 2 | | | | 1 | | | 5 |
| 08/21/09 | 1 | | | | | _ | | | | 3 | | | 3 |
| 08/19/09 | 1 | - 1 | | | | 2 | | | | 6 | 1 | | 8 |
| 08/18/09 | 1 | 1 | | | | | | | - | 3 | 1 | | 3 |
| 08/17/09 | 1 | 1 | | | | | 1 | | ļ | 6 | | | 8 |
| 08/16/09 | 1 | | | | | 1 | | | | 9 | | | 10 |
| 08/15/09 | 1 | | | | | 4 | | | | 3 | 1 | | 8 |
| 08/14/09 | 1 | | | 2 | | 1 | | | | 9 | 1 | | 13 |
| 08/12/09 | 1 | | | | | 4 | | | | 11 | 1 | | 16 |
| 08/11/09 | 1 | 1 | | 2 | | 4 1 | | | | 6 4 | | | 13 6 |
| 08/10/09 | 1 | 2 | | - | - | 8 | | | | 3 | 1 | | 14 |
| 08/09/09 | | | | | | | | | | 2 | | | 2 |
| 08/08/09 | | | | | | 5 | 1 | | | 15 | | | 21 |
| 08/07/09 | 1 | | | | | | | | | 2 | | | 2 |
| 08/06/09 | 1 | | | | | 1 | | | | 3 | 1 | | 5 |
| 08/05/09 | 1 | | | | | 1 | | | | 7 | | | 8 |
| 08/03/09 | 1 | | | 4 | | 2 | | | | 6 4 | | | 12 6 |
| 08/02/09 | | | | | | 1 | | | | 3 | | | 4 |
| 08/01/09 | 1 | | | | | 3 | | | | 6 | 1 | | 10 |
| 07/31/09 | 1 | | | | | 2 | | | | 5 | | | 7 |
| 07/30/09 | 1 | 1 | | | | 11 | | | | 10 | | | 22 |
| 07/28/09 | 1 | | | | | 1 | | | | 3 8 | | | 5 9 |
| 07/27/09 | | 1 | | | | 3 | | | | 25 | | | 29 |
| 07/26/09 | 1 | 1 | | | | 3 | | | | 7 | 2 | | 13 |
| 07/25/09 | 1 | 10 | | 15 | | 5 | | | | 2 | 10 | | 42 |
| 07/24/09 | 1 | | | 17 | | 1 | | | | 3 | 12 | | 32 |
| | | | | | | | | | | 4 | | | 2 |
| 07/22/09 | | | | 2 | | | | | | 4 | 3 | | 9 |



| Appendix D Ta | ble 2. Sum | nary of acous | tic bat data a | nd weather d | uring each su | rvey night at | the North Tre | e Detector. 20 | 009. | | | | | | |
|----------------------|--------------|---------------|----------------|---------------|---------------|---------------|--|----------------|------|--------|--|--|---------|--|--|
| | Die Z. Cam | Lay or doods | BBSH | NO W COMPANY | HB | MYSP | uno resur me | RBTB | | | UNKN | | | | |
| Night of | Operational? | BBSH | Big brown | Silver-haired | Hoary | ds.kw | Eastem red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total | | |
| 04/17/09 | 1 | ш | | 0) | _ | - | ш | - | Œ | | | | 0 | | |
| 04/18/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/19/09 04/20/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/20/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/22/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/23/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/25/09 | 1 | | | | | | | | | | | | Ö | | |
| 04/26/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/27/09 04/28/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/29/09 | 1 | | | | | | | | | | | | 0 | | |
| 04/30/09 05/01/09 | 1 1 | | | | | | | | | | | | 0 | | |
| 05/02/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/03/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/04/09 | 1 | | | | | | | | | 2 | | | 0 | | |
| 05/05/09 05/06/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/07/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/08/09 05/09/09 | 1 1 | 1 | | | | | 1 | | | | 1 | | 0 | | |
| 05/10/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/11/09 05/12/09 | 1 | _ | _ | | ļ | ļ | l | | | -1 | <u> </u> | <u> </u> | 0 1 | | |
| 05/13/09 | 1 | | | | L | L | | | | 1 | | | 0 | | |
| 05/14/09 | 0 | | | | | | | | | | | | 0 | | |
| 05/15/09 05/16/09 | 0 | | | - | | | 1 | - | - | - | l | 1 | 0 | | |
| 05/17/09 | 0 | | | | | | | | | | | | 0 | | |
| 05/18/09 05/19/09 | 0 | | | | | | | | | | | | 0 | | |
| 05/20/09 | 0 | | | | | | | | | | | | Ö | | |
| 05/21/09 | 0 | | | | | | | | | | | | 0 | | |
| 05/22/09 05/23/09 | 0 | | | | | | | | | | | | 0 | | |
| 05/24/09 | 0 | | | | | | | | | | | | 0 | | |
| 05/25/09 05/26/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/27/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/28/09 | 1 | | | | | | | | | | | | 0 | | |
| 05/29/09 05/30/09 | 1 | | | | | | | | | 1 | | | 0 | | |
| 05/31/09 | 1 | | | | | | | | | | | | 0 | | |
| 06/01/09 06/02/09 | 1 | | | | | | | | | | | | 0 | | |
| 06/03/09 | 1 | | | | | | | | | | 1 | | 1 | | |
| 06/04/09 06/05/09 | 1 | | | | | 3 | | | | 1 | | | 0 4 | | |
| 06/06/09 | 1 | | | | | 1 | | | | 1 | | | 2 | | |
| 06/07/09 06/08/09 | 1 1 | | | - | | | | | | 1 2 | | | 1 | | |
| 06/08/09 | 1 | | | 1 | | | | | | 2 | | | 3 0 | | |
| 06/10/09 | 1 | | | | | | | | | | 1 | | 1 | | |
| 06/11/09 06/12/09 | 1 | 1 | | | | 2 | | | | 3 | 7 | | 0 13 | | |
| 06/13/09 | 1 | 2 | | | | 1 | | | | | 1 | | 4 | | |
| 06/14/09 06/15/09 | 1 | | | | | 2 | | | | 2 | 2 | | 6 | | |
| 06/16/09 | 1 | | | | | | | | | | | | 0 | | |
| 06/17/09 | 1 | 1 | | | | | | | | | | | 1 | | |
| 06/18/09 06/19/09 | 1 | | | | | | | | | 1 | | | 0 | | |
| 06/20/09 | 1 | | | | | | | | | 1 | | | 1 | | |
| 06/21/09 06/22/09 | 1 | 1 | - | | | | | | | 1 | | | 1 1 | | |
| 06/23/09 | 1 | 2 | | | | 1 | | | | | | | 3 | | |
| 06/24/09 06/25/09 | 1 | 1 | | | | 1 | l | | | 1 | 2 | <u> </u> | 2 5 | | |
| 06/25/09 | 1 | 1 | | | | 1 | 1 | | | 1 | - | | 3 | | |
| 06/27/09 | 1 | | | | | 3 | | | | 3 | | | 6 | | |
| 06/28/09 06/29/09 | 1 | | | | | | 1 | | | 3 1 | l | l | 3 1 | | |
| 06/30/09 | 1 | | | | | | | | | 2 | | | 2 | | |
| 07/01/09 07/02/09 | 1 1 | - | - | | | | | | | | | | 0 | | |
| 07/03/09 | 1 | | | | | | | | | | | | 0 | | |
| 07/04/09 07/05/09 | 1 | | | | | | | | | 6 | | | 6 | | |
| 07/06/09 | 1 | 2 | | 1 | | 1 | | | | 16 | 2 | | 22 | | |
| 07/07/09 | 1 | | | | | | | | | | | | 0 | | |
| 07/08/09 07/09/09 | 1 | | | | | | | | 1 | 3 8 | 1 | | 4 10 | | |
| 07/10/09 | 1 | | | | | 1 | | | | 1 | | | 2 | | |
| 07/11/09 07/12/09 | 1 | - | | | | 1 | | | | 3 | | | 4 | | |
| 07/13/09 | 1 | | | | | | | | | Ĭ | | | 0 | | |
| 07/14/09 07/15/09 | 1 | 2 | | 10 | | 16 | | | | 28 | 7 | | 0 63 | | |
| 07/16/09 | 1 | | | 10 | | 3 | | | | 2 | | | 5 | | |
| 07/17/09 | 1 | | | | | | | | | 1 | | | 1 4 | | |
| 07/18/09 07/19/09 | 1 | | | | | 4 | | | | 1 | 1 | | 6 | | |
| 07/20/09 | 1 | 2 | | 9 | | 4 | | | | 2 | 18 | | 35 | | |
| 07/21/09 | 1 | | | | | 1 | | | | | | | 1 | | |



| By Spec | | 32 | 1 55 BBSH | 22 | 0 0 HB | 76 76 MYSP | 0 | 0 2 RBTB | 2 | 210 | 271 UNKN | 0 | 404 Total |
|----------------------|------|--|--|--|--------------|--|---|----------------|---|-----|-------------|---|--------------|
| By Spec | | 32 | | 22 | | | 0 | | 2 | 210 | | 0 | 404 |
| | rine | | - | | | | | | | | | | |
| | 1 | L | l | ! | | | | | | | | | 0 |
| 10/17/09 10/18/09 | 1 | | | | | | | | | | | | 0 |
| 10/16/09 | 1 | | | | | | | | | | | | 0 |
| 10/15/09 | 1 | | | | | | | | | | | | 0 |
| 10/13/09 | 1 | 1 | | | | | | | | | | | 0 |
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| Appendix D | Table 3. S. | ımmary of acı | oustic bat data | a and weathe | r during each | survey night | at the Centra | al Tree Detect | or, 2009. | | UNKN | | |
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| By Spe | 1 | | 0 | 685 | 0 | 52 | 0 | 0 | 0 | 307 | 360 | 0 | |
| | 1 | 118 | | - 30 | 0 | 52 | | 0 | | | 667 | | 1522 |
| By Gu | 1 ecies | 118 | | | HB | MYSP | | RBTB | | | UNKN | | Total |
| | 1 ecies | 118 | 803 | | | | | | | | J. 11/4 | | , ordi |
| 1 = Detector 1 | 1 ecies | 118 | | | . 10 | | | | | | | | |



| Appendix D | Table 4. Su | ımmary of acı | oustic bat data | a and weathe | r during each | survey night | at the South | Tower Detec | tor, 2009. | | UNKN | | |
|----------------------|--------------|---------------|-----------------|---------------|---------------|--------------|--------------|-------------|------------|----------|--|----------|----------|
| | | | ввон | | HB | MITSP | | KBIB | | | UNIAN | | |
| ıt of | Operational? | | Big brown | Silver-haired | ٨ | ٩ | Eastem red | Tri-colored | ω | z | z | z | Total |
| Night of | Ope | BBSH | Big | Silve | Hoary | MYSP | East | Ě | RBTB | N N | LFUN N | SN KN | |
| 04/16/09 | 1 | | | | | | | | | | | | 0 |
| 04/18/09 | 1 | | | | | | | | | | | | 0 |
| 04/19/09 | 1 | | | | | | | | | | | | 0 |
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| 06/08/09 | 1 | | | | | | | | | | | | 0 |
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| 06/14/09 06/15/09 | 1 | 19 | | 35 | 1 | 3 | | | | 1 | 33 | | 91 1 |
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| 06/17/09 06/18/09 | 1 | 3 | | 1 | | 1 | | | | 1 | 2 | | 8 |
| 06/19/09 | 1 | | | 3 | | | | | | | 2 | | 5 |
| 06/20/09 06/21/09 | 1 | 1 | | | | | | | | | | | 0 |
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| 07/18/09 | 1 | | | | | | 1 | | | 3 | | | 3 |
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| Appendix D Te | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 1 1 1 1 1 2 2 | | 2 5 138 48 48 97 1 1 | | 1 1 1 1 1 1 1 1 1 1 1 | | | 2 | 1 2 1 1 2 8 8 2 2 8 6 6 3 3 1 1 2 2 1 10 | 1 1 38 12 | 1 | 0 5 1 8 197 3 8 2 0 0 10 1 1 8 8 0 65 2 8 0 1 1 1 3 3 3 0 1 1 1 1 1 1 1 1 1 1 1 1 |
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| 9772309 9772509 9772509 9772509 9772509 9772509 9772509 9772509 9772509 9772509 9772509 9772509 9772709 9772509 9772709 980209 980209 980209 980209 980209 981209 | 1 | 1 19 4 1 1 | | 5 138 48 48 97 | | 2 1 1 1 1 1 1 1 | | | 2 | 2 1 2 8 2 8 6 5 2 6 3 | 1 38 | 1 | 1 8 197 3 8 2 0 10 10 11 8 8 0 0 65 2 8 3 0 132 1 3 3 18 |
| 0772409 0772509 0772609 0772609 0772609 0772609 0772809 0772809 0772809 0772809 0772809 080109 080109 080209 080409 080409 080409 080409 080409 080409 080409 080409 080409 080409 080409 080409 080409 081409 081409 081409 081409 081409 0814709 | 1 | 4 1 1 | | 138 48 97 1 4 | | 2 1 1 1 1 1 1 1 | | | 2 | 1 2 8 2 2 8 6 3 3 1 1 2 2 | 12 | 1 | 8 197 3 8 2 0 10 1 1 8 0 65 2 8 3 0 132 1 132 |
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| 0773090 0773109 0773109 0773109 0801109 0801109 080209 080300 080409 080509 080609 080609 080609 080609 080709 081109 | 1 | 1 | | 97 | | 1 1 1 1 | | | 2 | 8 6 5 2 6 3 | 31 | 1 | 0 10 1 8 0 65 2 8 3 0 132 1 3 |
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| 9773109 9802109 980309 980309 980309 980309 980309 980509 980509 980509 980709 98109 981109 | 1 | 1 | | 97 | | 1 1 1 1 | | | 2 | 6 5 2 6 3 | 31 | 1 | 1 8 0 65 2 8 3 0 132 1 3 |
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| 080609 080709 080809 080909 080909 081109 081109 081109 081309 081409 081509 081609 081609 081609 082009 082009 082509 082509 082609 082609 082709 082809 082709 082809 082809 082809 | 1 | 1 | | 1 4 | | 1 | | | 2 | 1 2 | | | 3 0 132 1 3 18 |
| 0807/09 080809 080909 081090 081109 081109 0811209 081209 081309 081509 081509 081509 081509 081509 081909 082109 082209 082309 082209 082209 082209 082309 082809 082809 082809 082909 082909 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 1 | | 1 4 | | 1 | | | | 1 2 | | | 0 132 1 3 18 |
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| 09/03/09 | 1 | | | | | | | | | | | | 0 |
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| 09/04/09 | 1 | | | | | | | | | 1 | | | 1 |
| 09/05/09 | 1 | | | | | 1 | | | | | | | 1 |
| 09/06/09 | 1 | | | | | | | | | 2 | | | 2 |
| 09/07/09 | 1 | | | | | | | | | | | | 0 |
| 09/08/09 | 1 | | | | | | | | | 11 | | | 11 |
| 09/09/09 | 1 | | | | | 1 | | | | 8 | 1 | | 10 |
| 09/10/09 | 1 | | | | | | | | | | | | 0 |
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| 09/23/09 | 1 | 1 | | | | 1 | | | | | | | 2 |
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| 10/01/09 | 1 | | | | | | | | | | | | 0 |
| 10/02/09 | 1 | 1 | | | | | | | | | | | 1 |
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| 10/17/09 | 1 | | | | | | — | | | | | | 0 |
| 10/18/09 | 1 | | | | | | | | | | | | 0 |
| By Spec | cies | 96 | 0 | 632 | 2 | 58 | 2 | 0 | 3 | 185 | 291 | 1 | 1270 |
| | ild | | 728 | | 2 | 58 | | 5 | | | 477 | | |
| By Guil | | | BBSH | | HB | MYSP | | RBTB | | | UNKN | | Total |
| By Gui | | | | | | | | | | | | | |



| Appendix D | Table 5. Su | ımmary of acc | oustic bat data | a and weathe | er during each | survey night | at the South | Tree Detecto | r, 2009. | | | | |
|----------------------|--------------|---------------|-----------------|---------------|--|--------------|--------------|--------------|----------|----------|----------|--|-----------|
| | | | BBSH | | HB | MYSP | | RBTB | | | UNKN | · | |
| Night of | Operational? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastem red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total |
| 04/16/09 | 1 | | | • | _ | _ | | | - | - | _ | _ | 0 |
| 04/17/09 | 1 | | | | | | | | | | | | 0 |
| 04/19/09 | 1 | | | | | | | | | | | | 0 |
| 04/20/09 | 1 | | | | | | | | | | | | 0 |
| 04/21/09 | 1 | | | | | | | | | | | | 0 |
| 04/23/09 | 1 | | | | | | | | | | | | 0 |
| 04/24/09 | 1 | | | | | | | | | 1 | | | 1 |
| 04/25/09 | 1 | | | | | 1 | | | | | | | 1 0 |
| 04/27/09 | 1 | | | | | | | | | | | | 0 |
| 04/28/09 | 1 | | | | | 1 | | | | | | | 0 |
| 04/30/09 | 1 | 1 | | | | | | | | 1 | | | 2 |
| 05/01/09 | 1 | | | | | | | | | | | | 0 |
| 05/02/09 05/03/09 | 1 | | | 1 | | | | | | 9 | | | 10 |
| 05/04/09 | 1 | | | | | | | | | 7 | | | 7 |
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| 05/07/09 | 1 | | | | | | | | | | | | 0 |
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| 05/12/09 05/13/09 | 1 | | | | | | | | | 18 | | | 18 |
| 05/14/09 | 1 | 1 | | | | | | | | | | | 1 |
| 05/15/09 05/16/09 | 1 | | <u> </u> | | <u> </u> | <u> </u> | | | | 13 | l | | 13 0 |
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| 05/22/09 05/23/09 | 1 | 2 | | | - | | | - | | 2 | 2 | | 4 |
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| 05/25/09 05/26/09 | 1 | 4 | | | | | | 1 | | 42 | | | 0 14 |
| 05/26/09 | 1 | 1 | | | | | | | | 13 | | | 0 |
| 05/28/09 | 1 | | | | | | | | | | | | 0 |
| 05/29/09 05/30/09 | 1 | | | | | | | | | 4 | - | | 4 |
| 05/31/09 | 1 | | | | | | | | | | | | 0 |
| 06/01/09 06/02/09 | 1 | | | | | 1 | | | | | - | | 0 |
| 06/03/09 | 1 | 1 | | | | | | | | 4 | | | 5 |
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| 06/07/09 | 1 | | | | | | | | | 2 | | | 2 |
| 06/08/09 06/09/09 | 1 | | | | | | | | | 2 | | | 0 |
| 06/10/09 | 1 | 1 | | | | 2 | | | | 17 | | | 20 |
| 06/11/09 | 1 | 1 | | 21 | 1 | 188 | | | - | 9 | 1 19 | 1 | 1 239 |
| 06/13/09 | 1 | 1 | | 3 | | 168 | | | | 19 | 5 | | 196 |
| 06/14/09 06/15/09 | 1 | 5 | | 19 | | 85 3 | | 1 | - | 9 | 16 | 3 | 137 3 |
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| 06/24/09 06/25/09 | 1 | 1 5 | | 14 | 1 | 18 5 | | | - | 1 | 10 | 1 | 44 21 |
| 06/26/09 | 1 | | | | | 24 | | | | 4 | | 1 | 29 |
| 06/27/09 06/28/09 | 1 | 1 | | 2 | - | 92 7 | | 1 | | 9 | 8 | | 112 12 |
| 06/29/09 | 1 | | | | | 65 | | | | 5 | | | 70 |
| 06/30/09 07/01/09 | 1 | 2 | | 2 | | 51 5 | | | | 3 | 1 2 | | 59 7 |
| 07/02/09 | 0 | | | | | | | | | | | | 0 |
| 07/03/09 | 1 | | | | | | | | | | | | 0 |
| 07/04/09 07/05/09 | 1 | | | | 1 | 11 | | | | 66 | | | 0 77 |
| 07/06/09 | 1 | 1 | | 40 | | 31 | | | | 365 | 27 | | 464 |
| 07/07/09 | 1 | | | 1 | | 56 | | 1 | | 1 143 | | | 200 |
| 07/09/09 | 1 | | | 4 | | 75 | | | | 187 | 6 | | 272 |
| 07/10/09 07/11/09 | 1 | | | | | 7 | | 1 | | 64 18 | 1 | | 72 20 |
| 07/12/09 | 1 | | | | | 1 | | | | 81 | | | 82 |
| 07/13/09 | 1 | | | | | | | | | 4 | | | 4 |
| 07/14/09 07/15/09 | 1 | 2 | | 3 | | 14 | | | | 4 615 | 2 | | 636 |
| 07/16/09 | 1 | | | | | 5 | | | | 72 | | | 77 |
| 07/17/09 07/18/09 | 1 | | | | 1 | 1 24 | | | | 56 81 | + | | 57 105 |
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